UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802- 4213

In reply refer to:
MAR 23 2004 SWR-01-SA-5675:MET

Mr. David Nicol
Acting Division Administrator
Federal Highway Administration
650 Capitol Mall, Suite 4-100
Sacramento, California 95814-4706

Dear Mr. Nicol:

This document transmits the National Marine Fisheries Service's (NOAA Fisheries) biological opinion (Enclosure 1) based on our review of the proposed Cypress Avenue Bridge Replacement project located in the City of Redding, Shasta County, California, and its effects on endangered Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*), threatened Central Valley spring-run Chinook salmon *(O. tshawytscha),* and threatened Central Valley steelhead *(O. mykiss*), in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16U.S.C. 1531 *et seq*.). Your February 20, 2003, request for formal consultation was received on March 11, 2003.

This biological opinion is based on information provided in the December 2002 biological assessment for the proposed project, several meetings and telephone conversations between NOAA Fisheries staff and representatives from the California Department of Transportation (Caltrans) and North State Resources, field investigations, and other sources of information. A complete administrative record of this consultation is on file at the NOAA Fisheries Sacramento Area Office.

Based on the best available scientific and commercial information, the biological opinion concludes that this project is not likely to jeopardize the above listed species or adversely modify designated critical habitat. NOAA Fisheries has also included an incidental take statement with reasonable and prudent measures and non-discretionary terms and conditions that are necessary and appropriate to minimize incidental take associated with the project.

Also enclosed are Essential Fish Habitat (EFH) conservation recommendations for Pacific salmon (Enclosure 2) as required by the Magnuson-Stevens Fishery Conservation and Management Act (MSA) as amended (16 U.S.C. 1801 *et seq.*). This document concludes that the Cypress Avenue Bridge Replacement project will adversely affect the EFH of Pacific Salmon in the action area and adopts the ESA reasonable and prudent measures and associated terms and conditions from the biological opinion as the EFH conservation recommendations.

Section 305(b)(4)(B) of the MSA requires the Federal Highway Administration (FHWA) to provide NOAA Fisheries with a detailed written response within 30 days, and 10 days in advance of any action, to the EFH conservation recommendations, including a description of measures adopted by FHWA for avoiding, minimizing, or mitigating the impact of the project on EFH [50 CFR 600.920(j)]. In the case of a response that is inconsistent with our recommendations, FHWA must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NOAA Fisheries over the anticipated effects of the proposed action and the measures needed to avoid, minimize, or mitigate such effects.

We appreciate your continued cooperation in the conservation of listed species and their habitat, and look forward to working with you and your staff in the future. If you have any questions regarding this document, please contact Mr. Michael Tucker in our Sacramento Area Office, 650 Capitol Mall, Suite 8-300, Sacramento, CA 95814. Mr. Tucker may be reached by telephone at (916) 930-3604 or by Fax at (916) 930-3629.

Sincerely,

Rodney R McInnis

Rodney R. McInnis
Acting Regional Administrator

Enclosures

cc: NOAA Fisheries-PRD, Long Beach, CA

Enclosure 1

BIOLOGICAL OPINION

AGENCY:	Federal Highway Administration
ACTIVITY:	Cypress Avenue Bridge Replacement Project
CONSULTATION CONDUCTED BY:	Southwest Region, National Marine Fisheries Service
FILE NUMBER:	151422SWR-01-SA-5675
DATE ISSUED:	MAR 23 2004

I. CONSULTATION HISTORY

In September 2000, an initial meeting was held to discuss the project that involved the California Department of Transportation (Caltrans), the City of Redding (City), several private consultants, the National Marine Fisheries Service (NOAA Fisheries), and the California Department of Fish and Game (DFG). In December 2001, an agency scoping session for the Notice of Preparation was held.

In February 2002, Caltrans submitted an administrative draft biological assessment (BA)/Essential Fish Habitat assessment (EFHA) to NOAA Fisheries and DFG for initial review and comment. NOAA Fisheries and DFG responded with comments to Caltrans and the project consultants in March 2002.

On May 22, 2002, a meeting was held involving Caltrans, project consultants, NOAA Fisheries, and DFG to discuss potential changes to the project description and associated effects on the environmental review process.

In July 2002, DFG submitted additional comments to Caltrans and the project consultants on the draft BA/EFHA.

On August 12, 2002, NOAA Fisheries submitted additional comments to Caltrans and the project consultants on the draft BA/EFHA.

On March 11, 2003, NOAA Fisheries received the final BA/EFH (North State Resources, Incorporated 2002) and request for initiation of formal consultation from Federal Highway Administration (FHWA).

On July 8, 2003, NOAA Fisheries requested a 60-day extension of the consultation period. No reply was received from FHWA.

II. DESCRIPTION OF THE PROPOSED ACTION

A. Project Activities

The City proposes to widen Cypress Avenue at its crossing of the Sacramento River in Redding, Shasta County, California. The City plans to replace the existing eastbound and westbound bridge structures with a single, widened structure to increase the number of traffic lanes from four to six (three in each direction) and to provide bicycle lanes and sidewalks in both directions.

The proposed project includes the following tasks:

- Build four new piers on pile-supported foundations *(i.e.,* three in the river channel and one on the east floodplain area).
- Remove seven existing piers *(i.e.,* five from the river channel and two on the east floodplain area).
- Construct a new cast-in-place bridge superstructure on essentially the same alignment as the existing bridge structures, but widened to the south.
- Remove existing bridge decks, steel girders, and piers to one foot below ground.
- Widen both sidewalks to provide overlook areas atop two or four piers at each side of the bridge, within the main river channel, and at each end of the bridge. Water features are being considered at each overlook. These features will be fully contained and utilize the City's existing municipal water supply.

It is anticipated that bridge replacement will require three in-river construction seasons, and possibly a fourth, which are described below by stage.

1. Stage 1

Stage 1 will include the installation of a temporary construction trestle downstream of the existing eastbound structure to facilitate in-water and over-water construction of the new bridge. Clean gravels will be used to build the approaches for the trestle, with the approaches extending into the river approximately 50 to 70 feet, depending on the depth of water. The trestle will be built out from the approaches on driven steel pile supports. The span lengths for a trestle are typically 30 to 40 feet, and will require 4 or 5 piles per support depending on the size of pile and the height of the trestle. Common pile sizes for this type of trestle are less than 18 inches in diameter. The trestle piles will be installed with diesel pile-driving hammers. In order to accommodate recreational boat traffic there will need to be a clear gap in the trestle near the middle of the river. This gap will require that each half of the trestle be built out and accessed from opposite sides of the river.

The temporary trestle will provide a platform from which to install the cofferdams for the three in-water bridge piers. Cofferdam and bridge pier construction methods will be similar for all three stages of the project. These construction methods are as follows:

1. Steel sheet piles will be vibrated into place with a vibratory hammer around the perimeter of the pier.

2. When the cofferdam perimeter has been sealed, the bottom of the inside of the cofferdam will be excavated down to the elevation of the bottom of the concrete portion of the new pier.

3. A template will be placed over or in the cofferdam to align the piles for driving, and the new piles will be driven into place inside the cofferdam.

4. After the piles have been driven into place, seal course concrete will be placed into the bottom of the cofferdam around the piles. The cofferdam will then be de-watered by pumping the water into settling basins on the shore.

5. The footings for the new bridge will then be formed and cast on top of the piles inside the cofferdam, followed by the forming and casting of the new pier walls.

Concurrent with the foundation work will be the construction of the falsework for the new superstructure. The falsework will be supported on piles driven into place. Typical falsework spans will be 30 to 50 feet, with four or five piles per support.

The falsework may be dismantled at the end of the first construction season, or could be left in place if the contractor has placed the falsework support in line with the new and existing piers, where there is little risk of flow impedance.

At the end of the in-water work season, most cofferdam sheet piles will be removed, but some sheet piles near the upstream end of the foundations may be left in pace to facilitate the installation and sealing of cofferdams in future stages of construction. After the cofferdam (and any falsework) is removed, the temporary work trestle and approach gravels will be removed, working in reverse order from the initial construction sequence. The contractor may elect to leave the temporary trestle piles in the riverbed so that the trestle can be reconstructed during stage 3 to provide access for the final falsework removal and final pier removal.

2. Stage 2

For stage 2 construction, the existing westbound bridge deck and girders will be removed, which can be done entirely from the top of the bridge during the winter season. A trestle for in-water access for stage 2 will be built on the north side of the existing bridge, as will the falsework and the new bridge superstructure, using similar techniques and sequencing as used in stage 1. The contractor will have the option of leaving the existing piers of the existing westbound bridge in place for use as falsework supports, or they may be completely removed during this stage.

3. Stage 3

For stage 3, the existing eastbound bridge, now in the middle between stage 1 and 2 bridges, will have the deck and girders removed. It is anticipated that the contractor will re-use the piles from stage 1 to build the trestle to the south. The cofferdams and piers will be built similar to the prior two stages. The falsework will be installed, and the superstructure will be constructed. Upon completion of stressing, the falsework and all cofferdam piles will be removed. The existing piers, if not already gone, will be completely removed as well. All finish work on the concrete surfaces above the water will be completed, and all remnants of the approach gravels and trestles will be completely removed from the river.

4. Pier Construction

The new pier foundations and pier walls will be built in three stages inside cofferdams installed each season, as described above. However, the project specifications will be written to allow the contractor to build all new pier foundations and pier walls to above the low-flow water elevation during the first season, as a contractor-initiated change. This construction procedure would require the use of specialized "low headroom" equipment not typically used by bridge contractors, but has the advantage of bringing the entire new bridge substructure up out of the water during the first season, eliminating the need for repeated cofferdam construction each subsequent season.

5. Existing Pier Removal

The existing piers will be completely removed during the final stage 3 season, with all concrete and piles removed to 1-foot below existing ground in conformance with the Caltrans Standard Specifications. Cofferdams will be built around each existing pier for access. Demolition of the existing piers will require the use of a hoe-ram to break up the concrete into manageable pieces for removal. The energy generated by the hoe-ram is typically much less than a pile-driving hammer, by a factor of 10. Specifically, the driving energy for a steel pile driver is approximately 75,000 ft-lbs, whereas the hoe-ram delivers around 7,500 ft-lbs of energy.

6. Contractor Staging and Storage Areas

Areas that are potentially available for the contractor's storage yard and primary staging area include the empty parcel on the east bank of the river south of Cypress Avenue and the area on the west bank of the river south of Park Marina Drive.

B. Proposed Conservation Measures

1. Loss of Shaded Riverine Aquatic (SRA) Habitat

The project would be designed to avoid and minimize losses to riparian vegetation adjacent to the river channel. Mature cottonwood trees located near construction areas will be flagged and avoided during construction to the fullest extent possible. In addition, exclusionary fencing shall be installed within construction access areas to ensure that impacts to riparian vegetation are minimized. When loss of riparian vegetation is unavoidable, the City will conduct habitat restoration activities using a ratio of 3:1 for each woody riparian plant and/or linear feet of SRA habitat removed due to project construction *(i.e.,* either due to temporary construction access or permanent loss associated with new piers).

The City has developed a riparian revegetation plan (Appendix A, in Biological Assessment) to address impacts to SRA habitat that occur during project construction. The revegetation plan identifies appropriate mitigation for impacts, describes planting techniques and locations, and incorporates planting of native species that would resist invasion by noxious plant species. The revegetation plan also was developed to address impacts to riparian wetlands for the U.S. Army Corps of Engineers under the Clean Water Act. All temporary impacts to riparian habitat would be mitigated on site, within the areas disturbed as a result of construction activities *(i.e.,* construction access routes, materials staging areas, *etc.).* If sufficient mitigation for permanent impacts to riparian vegetation cannot be accomplished on site, the City will purchase riparian wetlands at a ratio of 3:1 for acreage lost *(i.e., up* to 0.135 acres for 0.045 acres lost) at DFG's Battle Creek Riparian Mitigation site, which is located approximately 18 miles southeast of the project site.

2. Percussion Impacts to Incubating Salmonid Embryos

For in-stream percussive construction activities proposed for cofferdams, falsework, and work trestles, the following impact avoidance and minimization measures will be implemented:

- Prior to the start of project construction (between December and early March, depending upon flow conditions), the City will retain a qualified fishery biologist to conduct a survey for active redds and potential salmonid spawning habitat 450 feet upstream and downstream of proposed in-river construction activities. All active redds and areas currently supporting suitable spawning habitat shall be mapped.

- Anti-spawning matting will be placed over all suitable spawning areas identified 200 feet upstream and 200 feet downstream of the bridge, assuming small diesel hammers or vibratory hammers are used. For purposes of determining the limits of anti-spawning mat placement, small diesel hammers shall have an energy rating of less than 75,000 foot-pounds and small vibratory hammers shall have a rating of less than 4,500 inch-pounds. Hammers larger than this will require the installation of anti-spawning mats over all suitable spawning areas within 450 feet upstream and downstream of the in-river work area. Installation of the anti-spawning matting will be completed between March 1 and April 15 for each construction season requiring in-stream percussive work. Based on the significant amount of suitable spawning habitat located downstream of the bridge, continuous anti-spawning fence matting may be used in lieu of attaching pockets of matting to minimize the potential for matting to wash away. Due to the small amount of suitable spawning habitat located upstream, it is likely that mats can be effectively installed in patches for upstream areas.

- The contractor shall remove all anti-spawning matting between October 15 and October 30 (depending on flow conditions) of each construction season involving in-stream work.

- Anti-spawning mats will be monitored on a weekly basis and maintained in proper functioning condition *(i.e.,* secured to substrate without holes or establishment of spawning gravels on top of the mats). Should the anti-spawning mats not be functioning properly, all percussive construction work will cease until the mats have been restored to proper functioning condition.

- Provided anti-spawning mats are completely installed by April 15 of each construction season, percussive construction activities will occur between April 15 and October 15. To maximize contractor flexibility, the City may request authorization from NOAA Fisheries and DFG to conduct pile-driving activities during the time period from October 15 through April 14, without the placement of anti-spawning mats. It is expected that pile driving during this period would avoid potential effects to winter-run Chinook salmon eggs and pre-emergent fry. Based on initial conversations with NOAA Fisheries and DFG, such activities may be allowed, provided that a qualified fishery biologist has surveyed 450 feet upstream and downstream of the project and verified that no spawning activity is occurring. The City recognizes that these work windows could potentially coincide with spring-run Chinook salmon and Central Valley steelhead spawning activities and that unavoidable incidental take of these species could result from such activities.

3. Increased Turbidity and Suspended Sediment

To avoid or minimize potential impacts to listed salmonids related to increased turbidity and sedimentation, turbidity increases associated with project construction activities should not exceed the California Regional Water Quality Control Board, Central Valley Region (Regional

Board) water quality objectives for turbidity in the Sacramento River Basin (Regional Board 1998). Turbidity levels are defined in Nephelometric Turbidity Units (NTUs). The current thresholds for turbidity levels in the Sacramento River, as listed in the Water Quality Control Plan (Basin Plan) for the Central Valley (Regional Board 1998), are summarized below. Increases in turbidity attributable to controllable water quality factors shall not exceed the following limits:

- Where natural turbidity is between 0 and 5 NTUs, increases shall not exceed 1 NTU.
- Where natural turbidity is between 5 and 50 NTUs, increases shall not exceed 20 percent.
- Where natural turbidity is between 50 and 100 NTUs, increases shall not exceed 10 NTUs.
- Where natural turbidity is greater than 100 NTUs, increases shall not exceed 10 percent.

To ensure that turbidity levels do not exceed the thresholds listed above during in-stream project construction activities, the City shall retain a qualified water quality specialist to monitor turbidity levels 50 feet upstream and 300 feet downstream of the point of in-stream construction activities. When construction activities potentially have the greatest water quality impact *(e.g.,* during construction of new piers), water samples should be collected four times daily.

Gravel for the work trestle approaches shall meet the Caltrans Gravel Cleanliness Specification No. 85. The stable layer that will need to be placed for the gravel approaches shall consist of the cleanest possible materials *(i.e.,* metal sheets similar to air craft landing mats). If unclean materials such as dirt need to be used, they shall be enveloped in geotextile fabric over the clean gravel to contain the material and allow for a more complete and clean gravel removal from the river. Care shall be taken when removing gravel following completion of construction activities to ensure that turbidity levels are not exceeded due to the perturbation of dirt and debris that may accumulate in the gravel during construction. The bottom foot of gravel shall be left in the channel to avoid impacts to the natural bed of the river. Following the final stage of in-river construction, as much gravel as feasible *(i.e.,* while meeting State Reclamation Board requirements and allowing for boat passage) shall be left in the river channel to reduce potential turbidity and sedimentation impacts and to provide a source of suitable spawning gravel to be dispersed by natural flows in the river. Gravel that is to be removed and placed back into the river at a different location during construction of the project shall be rinsed off at an offsite facility to remove any sediment accumulation.

All water contained within the cofferdams shall be pumped to settling basins on the bank or into trucks for off-site disposal prior to removal of the cofferdam sheet piles. In addition, a Storm Water Pollution Prevention Plan (SWPPP) will be prepared and implemented that includes use of silt fences and sediment filters, and routine monitoring to verify effectiveness. All sediment containment devices and erosion control devices will be inspected daily during the construction period to ensure that they are properly functioning. Excavated and stored materials will be kept in upland sites with erosion control devices properly installed and maintained. All applicable erosion control standards will be required during stockpiling of materials.

4. Potential Spill of Hazardous Materials

Any construction equipment that would come in contact with the Sacramento River will be inspected daily for leaks prior to entering the flowing channel. External oil, grease, and mud will be removed from equipment using steam cleaning. Wash and rinse water must be adequately treated prior to discharge if that is the desired disposal option.

Hazardous materials, including fuels, oils, and solvents, will not be stored or transferred within 175 feet of the active Sacramento River channel. Areas for fuel storage, refueling, and servicing will be located at least 200 feet from the active river channel. Spill containment booms will be maintained onsite at all times during construction operations and/or staging of equipment or fueling supplies. Fueling trucks will carry a spill containment boom at all times.

5. Impaired Fish Passage During Construction

Adequate fish passage within the Sacramento River at the project site will be maintained at all times. Approximately 532 feet of river channel width will remain open for fish passage. This will allow the opportunity for fish to move away from active work areas and to have unabated passage to and through the project area.

6. Mortality of Incubating Salmonid Embryos, Rearing Juveniles, and Adult Salmonids During Construction

Placement of clean gravel within the Sacramento River channel to form construction access approaches to the work trestle could result in the direct mortality of incubating salmonid embryos and rearing juvenile salmonids as a result of entrapment and burial. To prevent the mortality of incubating salmonid embryos and rearing salmonids during this stage of construction, the following mitigation measures shall be applied:

- If Chinook salmon spawning habitat is present within the proposed gravel access approach areas, placement of gravel can occur from April 15 through October 15, provided that anti-spawning mats are placed over suitable spawning habitat prior to April 15. The placement of anti-spawning mats will prevent winter-run Chinook salmon from spawning within the gravel approach areas; therefore, potential mortality of incubating salmon embryos should be avoided. With regard to placement of gravel approaches, anti-spawning mats shall be removed immediately prior to the placement of gravel.

- If no spawning habitat is present in the gravel access approach zones then placement of the gravel construction work bar shall be limited to the period between January 15 and October 15.

- To avoid impacts to mobile life stages of salmonids that may be present in the water column, the first layers of clean gravel that are being placed into the wetted channel shall be added slowly and deliberately to allow fish to move away from the work area.

When driven sheet piles and/or vibrated sheet piles are installed as part of the project, the following mitigation measures shall be implemented to reduce potential entrainment of salmonids (adults, rearing juveniles, and fry):

- Cofferdam construction will be completed at the downstream end to minimize the potential for entrainment of salmonids within a closed cofferdam.

- A qualified fishery biologist shall inspect or sample the closed cofferdam to ensure that no salmonids have been trapped within the cofferdam. Any entrained salmonids shall be removed and returned to the river. The fishery biologist shall note the number of individuals entrained, the number of individuals relocated, and the date and time of collection and relocation. One or more of the following NOAA Fisheries-approved capture techniques shall be used: dip net, seine, throw net, minnow trap, or hand. Electrofishing may be used if NOAA Fisheries has reviewed the biologist's qualifications and provided written approval. The fishery biologist shall be empowered to halt work activity and to recommend measures for avoiding adverse effects to salmonids and their habitat.

C. Description of the Action Area

The action area is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR §402.02). The action area, for the purpose of this Opinion, encompasses an area that begins 450 feet upstream of the Cypress Avenue Bridge and extends 500 feet downstream of the Cypress Avenue Bridge. This area was selected because it represents the upstream extent of anticipated acoustic effects from pile driving, and the downstream extent of anticipated effects related to sediment and turbidity.

III. STATUS OF THE SPECIES AND CRITICAL HABITAT

The following listed endangered and threatened species and designated critical habitat occur in the action area and may be affected by the proposed Cypress Avenue Bridge Replacement project:

- Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*)–endangered
- Sacramento River winter-run Chinook salmon critical habitat
- Central Valley spring-run Chinook salmon (*O. tshawytscha*)–threatened
- Central Valley steelhead (*O. mykiss*)–threatened

A. Species Life History, Population Dynamics, and Likelihood of Survival and Recovery

1. Sacramento River Winter-Run Chinook Salmon

Sacramento River winter-run Chinook salmon were originally listed as threatened in November, 1990 (55 FR 46515). Their status was reclassified as endangered in January, 1994 (59 FR 440) due to continued decline and increased variability of run sizes since their listing as a threatened species, expected weak returns as a result of two small year classes in 1991 and 1993, and continued threats to the population. In the proposed rule to reclassify the winter-run Chinook salmon as endangered, NOAA Fisheries recognized that the population had dropped nearly 99 percent between 1966 and 1991, and despite conservation measures to improve habitat conditions, the population continued to decline (57 FR 27416). A draft recovery plan was published in August 1997 (NOAA Fisheries 1997).

Winter-run Chinook salmon historically spawned in the headwaters of the McCloud, Pit, and Little Sacramento rivers and Hat and Battle creeks. Construction of Shasta Dam in 1943 and Keswick Dam in 1950 blocked access to all of these waters except Battle Creek, which has been severely impacted by hydroelectric facilities and the Coleman National Fish Hatchery (Moyle *et al.* 1989, NOAA Fisheries 1997). Until 1984, the upper Calaveras River also contained a run of several dozen to several hundred fish that spawned below New Hogan Dam. Low river flows in the Calaveras during the 1987-1992 drought are believed to have eliminated this population (DFG 1998). Most of the current winter-run Chinook salmon spawning and rearing habitat exists on the mainstem Sacramento River between Keswick Dam and Red Bluff Diversion Dam (RBDD). Although a small, unknown, number of winter-run Chinook salmon are thought to spawn in Battle Creek, the ESU is widely considered to be reduced to a single naturally spawning population in the mainstem Sacramento River below Keswick Dam.

Following the construction of Shasta Dam, the number of winter-run Chinook salmon initially declined but recovered during the 1960s. This initial recovery was followed by a steady decline from 1969 through the late 1980s [U.S. Fish and Wildlife Service (FWS) 1999].

Adult winter-run Chinook salmon enter San Francisco Bay from November through June (Hallock and Fisher 1985) and migrate past RBDD from mid-December through early August (NOAA Fisheries 1997). The majority of the run passes RBDD from January through May, and peaks in mid-March (Hallock and Fisher 1985). Generally, winter-run Chinook salmon spawn from near Keswick dam, downstream to Red Bluff. Spawning occurs from late-April through mid-August with peak activity between May and June. Eggs and pre-emergent fry require water temperatures at or below 56 °F for maximum survival during the spawning and incubation period (FWS 1999). Fry emerge from mid-June through mid-October and move to river margins and tributary streams to rear. Emigration past RBDD may begin in mid-July and typically peaks in September and can continue through March in dry years (NOAA Fisheries 1997, Vogel and Marine 1991). From 1995 to 1999, all winter-run Chinook salmon outmigrating as fry passed

RBDD by October, and all outmigrating pre-smolts and smolts passed RBDD by March (Martin *et al.* 2001).

Construction of RBDD in 1966 enabled improved accuracy of population estimates as salmon passed through fish ladders. From 1967 to 2000, winter-run Chinook salmon estimates were extrapolated from adult counts at RBDD ladders. Recent operational changes at RBDD have allowed a majority of the winter-run Chinook salmon population to bypass the ladders and counting facilities, and has increased the error associated with extrapolating the population estimate. Beginning in 2001, carcass counts replaced the ladder count to reduce the error associated with the estimate.

Since 1967, the estimated adult winter-run Chinook salmon population ranged from 186 in 1994 to 117,808 in 1969 (DFG 2002). The estimate declined from an average of 86,000 adults in 1967-1969 to only 2,000 by 1987-1989, and continued downward to an average 830 fish in 1994-1996. Since then, estimates have increased to an average of 3,136 fish for the period of 1998-2001. Winter-run abundance estimates and cohort replacement rates since 1986 are shown in Table 1. Although the population estimates display broad fluctuation since 1986 (186 in 1994 to 9,757 in 2003), there is an increasing trend in the five year moving average over the last five year period (491 from 1990-1994 to 5,451 from 1999-2003), and a generally stable trend in the five year moving average of cohort replacement rates. The 2003 run was the highest since the listing, with an estimate of 9,757 adult fish.

Table 1. Winter-run Chinook salmon population estimates from Red Bluff Diversion Dam counts, and corresponding cohort replacement rates for the years since 1986.

Year	Population Estimate	5 Year Moving Average of Population Estimate	Cohort Replacement Rate	5 Year Moving Average of Cohort Replacement Rate
1986	2596	-	0.60	-
1987	2186	-	0.22	-
1988	2886	-	0.10	-
1989	697	-	1.63	-
1990	431	1759	0.75	0.66
1991	211	1282	1.23	0.79
1992	1241	1093	1.10	0.96
1993	387	593	1.88	1.32
1994	186	491	6.64	2.32
1995	1287	662	1.83	2.54
1996	1337	888	1.30	2.55
1997	880	815	3.51	3.03
1998	3005	1339	0.80	2.82
1999	3288	1959	1.16	1.72
2000	1352	1972	-	-
2001	5523	2809	-	-
2002	7337	4101	-	-
2003	9757	5451		

2. Central Vallev Spring-Run Chinook Salmon

NOAA Fisheries listed the Central Valley spring-run Chinook salmon ESU as threatened on September 16, 1999 (64 FR 50394). Historically, spring-run Chinook salmon were the dominant run in the Sacramento River Basin, occupying the middle and upper elevation reaches (1,000-6000 ft) of most streams and rivers with sufficient habitat for over-summering adults (Clark 1929). Clark estimated that there were 6,000 miles of salmon habitat in the Central Valley Basin (much which was high elevation spring-run Chinook salmon habitat) and that by 1928, 80 percent of this habitat had been lost. Yoshiyama *et al.* (1996) determined that, historically, there were approximately 2,000 miles of salmon habitat available prior to dam construction and mining and that only 18 percent of that habitat remains.

Adult spring-run Chinook salmon enter the Delta from the ocean beginning in January and enter natal streams from March to July. In Mill Creek, Van Woert (1964) noted that of 18,290 spring-run Chinook salmon observed from 1953 to 1963, 93.5 percent were counted between April 1 and July 14, and 89.3 percent were counted between April 29 and June 30.

During their upstream migration, adult spring-run require streamflows sufficient to provide olfactory and other orientation cues used to locate their natal streams. Adequate streamflows are also necessary to allow adult passage to upstream holding habitat. The preferred temperature range for spring-run Chinook salmon upstream migration is 38 °F to 56 °F (Bell 1991, DFG 1998). Spring-run may also utilize tailwaters below dams if cold water releases are suitable.

Upon entering fresh water, spring-run Chinook salmon are sexually immature and must hold in cold water for several months to mature. Typically, spring-run Chinook salmon utilize mid to high elevation streams that provide sufficient flow, water temperature, and cover, and pool depth to allow over-summering.

Spawning occurs between September and October and, depending on water temperature, emergence occurs between November and February. The optimum temperature range for Chinook salmon egg incubation is 44 °F to 54 °F (Velson 1987). Incubating eggs show reduced viability and increased mortality at temperatures greater than 58 °F and show 100 percent mortality for temperatures greater than 63 °F. Velson (1987) and Beacham and Murray (1990) found that developing Chinook salmon embryos exposed to water temperatures of 35 °F or less before the eyed stage experienced 100 percent mortality (DFG 1998).

Timing of emergence is strongly influenced by water temperature. Early emergence (November-December) is common at warmer low elevation habitats such as in Big Chico and Butte Creeks, while later emergence (January-February) is more typical in the cooler higher elevation habitats of Deer and Mill Creeks (DFG 1998, Colleen Harvey-Arrison, DFG, pers. comm., 1999). Post-emergent fry move to shallow, near shore areas with slow current and good cover, and feed on small terrestrial and aquatic insects. As they grow to 50 to 75 mm in length, the juvenile salmon move out into deeper, swifter water, but continue to use available cover to minimize the risk of predation and reduce energy expenditure.

Spring-run emigration is highly variable (DFG 1998). Some juveniles may begin outmigrating soon after emergence, whereas others oversummer and emigrate as yearlings with the onset of increased fall storms (DFG 1998). The emigration period for spring-run Chinook salmon extends from November to early May.

Outmigrants may rear in non-natal tributaries to the Sacramento River, and in the Sacramento-San Joaquin Delta. In general, emigrating juveniles that are younger (smaller) reside longer in the Delta (Kjelson *et al.* 1982, Levy and Northcote 1982, Healey 1991). Juvenile spring-run fish can enter the Delta as early as January and as late as June. Their length of residency within the Delta is unknown but probably lessens as the season progresses into the late spring months (DFG 1998).

Chinook salmon spend between one and four years in the ocean before returning to their natal streams to spawn (Myers *et al.* 1998). Fisher (1994) reported that 87 percent of Chinook salmon trapped and examined at RBDD between 1985 and 1991 were three-years-olds.

Spring-run Chinook salmon were once the most abundant run of salmon in the Central Valley (Campbell and Moyle 1992) and were found in both the Sacramento and San Joaquin drainages. More than 500,000 spring-run Chinook salmon were caught in the Sacramento- San Joaquin commercial fishery in 1883 alone (Yoshiyama *et al.* 1998). Principal holding and spawning areas were in the middle reaches of the San Joaquin, American, Yuba, Feather, upper Sacramento, McCloud, and Pit Rivers with smaller populations in tributaries with cold water conditions suitable to support the fish through the summer. The San Joaquin populations were essentially extirpated by the 1940s, with only small remnants of the run that persisted through the 1950s in the Merced River (Hallock and Van Wort, 1959, Yoshiyama 1998). Populations in the upper Sacramento, Feather, and Yuba Rivers were eliminated with the construction of major dams during the 1950s and 1960s. Naturally spawning populations of spring-run Chinook salmon are currently restricted to accessible reaches of the upper Sacramento River, Antelope Creek, Battle Creek, Beegum Creek, Big Chico Creek, Butte Creek, Clear Creek, Deer Creek, Mill Creek, Feather River, and the Yuba River (DFG 1998).

Since 1969, the spring-run Chinook salmon ESU has displayed broad fluctuations in abundance, ranging from 1,403 in 1993 to 25,890 in 1982. The average abundance for the ESU was 12,590 for the period of 1969 to 1979, 13,334 for the period of 1980 to 1990, and 6,554 from 1991 to 2001. Evaluating the abundance of the ESU as a whole, however, masks significant changes that are occurring among metapopulations. For example, while the mainstem Sacramento River population has undergone a significant decline, the tributary populations have demonstrated a substantial increase. Average abundance of spring-run Chinook salmon has declined from a high of 12,107 for the period of 1980 to 1990, to a low of 629 from 1991 to 2001, while the average abundance of Sacramento River tributary populations increased from a low of 1,227 to a high of

5,925 over the same period. Although tributaries such as Mill and Deer Creeks have shown positive trends in spring-run Chinook salmon abundance since 1991, recent escapements to Butte Creek, including 9,605 in 1998 and 20,259 in 2001, are responsible for the overall increase in tributary abundance (DFG unpublished data).

3. Central Valley Steelhead

NOAA Fisheries listed the Central Valley steelhead (steelhead) ESU as threatened on March 19, 1998 (63 FR 13347). This ESU includes all naturally-produced steelhead in the Sacramento-San Joaquin River Basin. NOAA Fisheries published a final 4(d) rule for steelhead on July 10, 2000 (65 FR 42422).

Steelhead are similar to Pacific salmon in their life history requirements in that they are born in fresh water, emigrate to the ocean, and return to freshwater to spawn. Unlike other Pacific salmon, steelhead are capable of spawning more than once before they die.

All steelhead stocks in the Central Valley of California are winter-run steelhead (McEwan and Jackson 1996). The majority of the Central Valley steelhead spawning migration occurs from October through February and spawning occurs from December to April in streams with cool, well-oxygenated water that is available year round. Van Woert (1964) observed that in Mill Creek, the steelhead migration is continuous, and although there are two peak periods, 60 percent of the run is passed by December 30. Similar bimodal run patterns have also been observed in the Feather River (Ryan Kurth, California Department of Water Resources, pers. comm., 2002), and the American River (John Harmon, U.S. Bureau of Reclamation, pers. comm., 2002).

Incubation time is dependent upon water temperature. Eggs incubate for one-and-a-half to four months before emerging. Eggs held between 50 and 59 °F hatch within three to four weeks (Moyle 1976). Fry emerge from redds within in about four to six weeks depending on redd depth, gravel size, siltation, and temperature (Shapovalov and Taft 1954). Newly emerged fry move to shallow stream margins to escape high water velocities and predation (Barnhart 1986). As fry grow larger they move into riffles and pools and establish feeding locations. Juveniles rear in freshwater for one to four years (Meehan and Bjornn 1991) emigrating episodically from natal springs during fall, winter and spring high flows (Colleen Harvey-Arrison, DFG, pers. comm., 2002). Steelhead typically spend two years in fresh water. Adults spend one to four years at sea before returning to freshwater to spawn as four- or five-year-olds (Moyle 1976).

Steelhead historically were well-distributed throughout the Sacramento and San Joaquin Rivers (Busby *et al* 1996). They were found from the upper Sacramento and Pit River systems south to the Kings and possibly the Kern River systems and in both east- and west-side Sacramento River tributaries (Yoshiyama *et al.* 1996). The present distribution of steelhead has been greatly reduced (McEwan and Jackson 1996). The California Advisory Committee on Salmon and Steelhead (1988) reported a reduction of steelhead habitat from 6,000 miles historically to 300 miles. The California Fish and Wildlife Plan (DFG 1965) estimated there were 40,000 steelhead in the early 1950s. Hallock *et al* (1961) estimated an average of 20,540 adult steelhead through the 1960s in the Sacramento River, upstream of the Feather River.

Existing wild steelhead stocks in the Central Valley are mostly confined to upper Sacramento River and its tributaries, including Antelope, Deer, and Mill Creeks and the Yuba River. Populations may exist in Big Chico and Butte Creeks and a few wild steelhead are produced in the American and Feather Rivers (McEwan and Jackson 1996). Until recently, steelhead were thought to be extirpated from the San Joaquin River system. Recent monitoring has detected self sustaining populations of steelhead in the Stanislaus, Mokelumne, Calaveras, and other stream previously thought to be void of steelhead (McEwan 2001). It is possible that naturally spawning populations exist in many other streams but are undetected due to lack of monitoring programs (Interagency Ecological Program Steelhead Project Work Team 1999).

Reliable estimates of steelhead abundance are not available (McEwan 2001). However, McEwan and Jackson (1996) estimate the total annual run size for the entire system, based on RBDD counts, to be no more than 10,000 adults. Steelhead counts at the RBDD have declined from an average of 11,187 for the period of 1967 to 1977, to an average of approximately 2,000 through the 1990s (McEwan and Jackson 1996, McEwan 2001). Recent estimates from trawling data in the Sacramento-San Joaquin Delta suggest that approximately 3,600 wild female steelhead spawn in the Central Valley basin, and that approximately 181,000 juveniles are produced (NOAA Fisheries 2003).

B. Critical Habitat Condition and Function for Species' Conservation

The only species addressed in this opinion which has currently designated critical habitat is the winter-run Chinook salmon. Critical habitat for winter-run Chinook salmon was designated on June 16, 1993 and includes the Sacramento River from Keswick Dam (river mile [RM] 302) downstream to Chipps Island (RM O) at the westward margin of the Sacramento-San Joaquin Delta; all waters from Chipps Island westward to Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and Carquinez Strait; all waters of San Pablo Bay westward of the Carquinez Bridge; and all waters of the San Francisco Bay (north of the San Francisco Bay Bridge) from San Pablo Bay to the Golden Gate Bridge. The critical habitat designation identifies those physical and biological features of the habitat that are essential to the conservation of the species and that may require special management consideration or protection. Within the Sacramento River this includes the river water, river bottom (including those areas and associated gravel used by winter-run Chinook salmon as spawning substrate), and adjacent riparian zone used by fry and juveniles for rearing.

The spawning habitat for winter-run Chinook salmon within the upper Sacramento River (from Keswick Dam to Red Bluff Diversion Dam) currently provides good spawning and incubation conditions. Since the construction of the temperature control device on Shasta Dam, cold water releases generally provide appropriate water temperatures throughout the primary spawning area during the spawning and incubation periods (April through September). An aggressive spawning gravel supplementation program regularly introduces spawning gravel of the appropriate size, shape and cleanliness into the upper spawning areas. Based on a 1980 survey of spawning sites available between Keswick Dam and Red Bluff Dam, it was determined there were approximately 96,000 sites available at that time (DFG 2001). Based on the large number of potential spawning sites and the relatively small number of returning winter-run Chinook salmon at this time (generally between 1,000 and 10,000 adults over the last five years; Table 1), it does not appear that the spawning-related elements of critical habitat are limiting the recovery of winter-run Chinook salmon.

The critical habitat downstream of RBDD is primarily used as juvenile rearing habitat and as a migrational corridor for both upstream migrating adults and downstream migrating juveniles. The condition and function of this habitat has been severely impaired through several factors discussed in the following section. The result has been the reduction in quantity and quality of several essential elements of rearing habitat necessary in allowing juveniles to reach and maintain the proper physical condition to survive in the ocean.

C. Factors Affecting the Species and Critical Habitat

1. Sacramento River Winter-Run Chinook Salmon

The primary factor impacting winter-run Chinook salmon was the construction of Shasta and Keswick Dams, which effectively cut these fish off from the vast majority of their natural spawning range. Since the completion of those dams, numerous additional factors have contributed to the continued decline of winter-run Chinook salmon by degrading their remaining spawning, rearing, and migration habitats. Between the time that Shasta Dam was built and the listing of winter-run Chinook salmon as endangered, the major impact sources have included warm water releases from Shasta Dam, juvenile and adult passage constraints at RBDD, water exports in the southern Sacramento-San Joaquin Delta, acid mine drainage from Iron Mountain Mine, and entrainment at a large number of unscreened or poorly-screened water diversions. Secondary factors that have contributed to the decline of winter-run Chinook salmon include smaller water manipulation facilities and dams, loss of rearing habitat in the lower Sacramento River and Sacramento-San Joaquin Delta from levee construction and marshland reclamation, and competitive and predatory interactions with introduced species (NOAA Fisheries 1997).

Since the listing of winter-run Chinook salmon, many habitat problems that led to the decline of the species have been addressed and improved through restoration and conservation actions. The impetus for initiating restoration actions stem primarily from ESA requirements, State Water Resources Control Board (State Board) orders requiring compliance with Sacramento River water temperature objectives, a 1992 amendment to the authority of the Central Valley Project (CVP) through the Central Valley Project Improvement Act (CVPIA) to give fish and wildlife equal priority with other CVP objectives, fiscal support of habitat improvement projects from the CALFED Bay-Delta Program, and EPA pollution control efforts.

The 1993 biological opinion (NOAA Fisheries 1993) that addressed the effects of the Bureau of Reclamation's (BOR) operation of the CVP and the California Department of Water Resource's (DWR) operation of the State Water Project (SWP) on Sacramento River winter-run Chinook salmon (winter-run opinion) identified reasonable and prudent alternatives (RPAs) necessary to avoid the likelihood of jeopardizing the species. Some of the RPAs include a minimum end-of-the-year carryover storage in Shasta Reservoir of 1.9 million acre feet, minimum flow requirements of 3,250 cubic feet per second (cfs) from Keswick Dam from October 1 through March 31, identification of ramp down rates to minimize stranding of juveniles, water temperature objectives of no more than 56° F from Keswick Dam to Jelly's Ferry or Bend Bridge, depending on the water year type, adjusted operational schedule of RBDD to facilitate maximum upstream passage of adults and downstream passage of juveniles, and closing of the Delta Cross Channel (DCC) gates from February 1 to April 30, and monitored operation of the DCC gates from October 1 through January 31 to reduce the diversion of juvenile emigrants into the Delta.

The winter-run opinion, along with State Board water temperature compliance orders, led to the construction of a temperature control device (TCD) at Shasta Dam. The TCD became operable in 1997 and has allowed improved water temperature management by allowing the BOR cold water releases from Shasta Reservoir.

With the passage of the CVPIA in 1992, the Secretary of the Interior was directed to develop the Anadromous Fish Restoration Program (AFRP) and make all reasonable efforts to at least double natural production of anadromous fish in California's Central Valley streams. Numerous actions have been funded to increase winter-run Chinook salmon production, including acquisition of Sacramento River riparian habitat, increased law enforcement, fish screens at major Sacramento River diversions, and spawning gravel augmentation. Section b(2) of the CVPIA also established a water account to provide water for anadromous fish, and to improve water quality in the Delta. This water commonly is used to minimize the effects of flow fluctuations by supplementing CVPIA minimum flow requirements.

The CALFED Bay-Delta Program (CALFED) was established in 1995 with a mission to develop and implement a long-term comprehensive plan that will restore ecological health and improve water management for beneficial uses of the Bay-Delta System. Fundamental to this plan is a goal of recovering at-risk native species dependant on the Delta and Suisun Bay, including anadromous salmonids of the Central Valley. To aid this plan, CALFED established the Ecosystem Restoration Program (ERP) to guide restoration actions. To date, CALFED has funded numerous restoration projects that benefit winter-run Chinook salmon, including state-of-the-art fish screens and fish passage facilities at Anderson-Cottonwood Irrigation District (ACID) diversion and dam, Glenn-Colusa Irrigation District (GCID), Reclamation District 108, Princeton-Cordura-Glenn & Provident Irrigation District, and other smaller diversions. In addition to the ERP, CALFED also established an Environmental Water Account (EWA) to increase protection of anadromous fish through better management of Central Valley water. The account buys water from willing sellers or diverts surplus water when safe for fish, then banks, stores, transfers, and releases it as needed to protect fish and compensate water users. EWA managers also coordinate with water project operators to curtail pumping at specific times to avoid harming fish.

Since 1986, the U.S. Environmental Protection Agency (EPA) has implemented remedial actions at Iron Mountain Mine. The completion of a lime neutralization plant is successfully removing significant concentrations of toxic metals in acidic mine drainage from the Spring Creek watershed. According to the EPA, the existing pollution control system removes up to 75 percent of the toxic compounds emitted from the mine. A large dam currently under construction on Slickrock Creek will ultimately enable a 95 percent toxicity reduction.

NOAA Fisheries' 1997 draft recovery plan for winter-run Chinook salmon states that when the underlying causes of the species' decline are no longer in effect and the species has reached population levels in which the probability of extinction is very low, it can be removed from the endangered species list (NOAA Fisheries 1997). In general, the population criteria for delisting winter-run Chinook salmon requires the mean annual spawning abundance over any thirteen consecutive years shall be 10,000 females and the geometric mean of the cohort replacement rate (CHR) over those same thirteen years shall be greater than 1.0. Estimates of these criteria shall be based on natural production alone and shall not include hatchery fish. Recent trends in winter-run Chinook salmon abundance and cohort replacement are positive and indicate some recovery since the listing, however, the population remains well below the recovery goals of the draft recovery plan, and is particularly susceptible to extinction due to loss of genetic variation resulting from the reduction of the ESU to one population.

2. Central Valley Spring-Run Chinook Salmon

The initial factors affecting the decline of Central Valley spring-run Chinook salmon primarily stem from the loss of upstream habitat behind impassible dams. Since this initial loss of habitat, spring-run Chinook salmon populations have continued to decline. This continuing decline is due to a combination of physical, biological, and management conditions, including climatic variation, water management, hybridization, predation, and harvest (DFG 1998).

Weather and ocean conditions in California can vary substantially from year to year. During the drought of 1984 to 1992, Central Valley spring-run Chinook salmon populations declined substantially. Reduced flows resulted in warm water temperatures and impacted adults, eggs, and juveniles. For adult spring-run Chinook salmon, reduced instream flows delayed or completely blocked access to holding and spawning habitats. Water management operations, including reservoir releases and operation of unscreened or poorly-screened diversions in the Sacramento River and tributaries, and in the Sacramento-San Joaquin Delta, compounded drought-related problems by reducing river flows, warming river temperatures, and entraining juvenile spring-run Chinook salmon.

Hatchery practices, as well as spatial and temporal overlaps of habitat use and spawning activity between Central Valley spring-run Chinook salmon and Central Valley fall-run Chinook salmon

(O. tshawytscha) has led to the hybridization and homogenation of some subpopulations (DFG 1998). As early as the 1960s, Slater (1963) observed that early fall-run adults were competing with spring-run adults for spawning sites in the Sacramento River below Keswick Dam and speculated that the two runs may have hybridized. Feather River hatchery-produced spring-run Chinook salmon have been documented as straying throughout Central Valley streams for many years (DFG 1998), and in many cases have been recovered from the spawning grounds of fall-run Chinook salmon (Colleen Harvey-Arrison, DFG, pers. comm., 2002), an indication that Feather River Hatchery spring-run may exhibit fall-run life history characteristics. Although the degree of hybridization has not been comprehensively determined, it is clear that the populations of spring-run Chinook salmon spawning in the Feather River and counted at RBDD contain hybridized fish.

Accelerated predation may also be a factor in the decline of Central Valley spring-run Chinook salmon. Although predation is a natural component of the spring-run Chinook salmon life history, the rate of predation has increased through the introduction of non-native predatory species such as striped bass and largemouth bass, and augmented through the alteration of natural flow regimes and the development of structures that attract predators, including dams, bank revetment, bridges, diversions, piers, and wharfs (Stevens 1961, Vogel *et al.* 1988, Garcia 1989, Decato 1978). FWS found that more predatory fish were found at rock revetment bank protection sites between Chico Landing and Red Bluff than at sites with naturally eroding banks (Michny and Hampton 1984). On the mainstem Sacramento River, high rates of human induced predation are known to occur at RBDD, ACID, GCID, and at the south Delta water diversion structures (DFG 1998). From October 1976 to November 1993, DFG conducted ten mark/recapture experiments at the SWP Clifton Court Forebay to estimate pre-screen losses using hatchery-reared juvenile Chinook salmon. Pre-screen losses ranged from 69 to 99 percent. Predation from striped bass was thought to be the primary cause of the loss (DFG 1998; Gingras 1997).

Spring-run Chinook salmon are harvested in ocean commercial, ocean recreational, and inland recreational fisheries. Coded wire tag returns indicate that Sacramento River salmon congregate off the coast between Point Arena and Morro Bay. Ocean fisheries have affected the age structure of spring-run Chinook salmon through targeting large fish for many years and reducing the number of four and five year olds (DFG 1998). An analysis of six tagged groups of Feather River Hatchery spring-run Chinook salmon by Cramer and Demko (1997) indicates that harvest rates of three-year-old fish ranged from 18 to 22 percent, four-year-olds ranged from 57 to 84 percent, and five-year-olds ranged from 97 to 100 percent. Reducing the age structure of the species reduces its resiliency to factors that may impact a year class. In-river recreational fisheries historically have taken fish throughout the species' range. During the summer, holding adult spring-run Chinook salmon are easily targeted by anglers when they congregate in large pools. Poaching also occurs at fish ladders, and other areas where adults congregate; however, the significance of poaching on the adult population is unknown.

Several actions have been taken to improve habitat conditions for spring-run Chinook salmon, including improved management of Central Valley water, new and improved screen designs at major water diversions along spring-run Chinook salmon tributaries, and the mainstem Sacramento, and changes in ocean and inland fishing regulations to minimize harvest. Fish screen improvements, and EWA and b(2) water accounts increase protection of anadromous fish through better management of Central Valley water.

In recent years, ocean and in-river fisheries have been modified to reduce the harvest of spring-run Chinook salmon. Ocean regulation changes include increasing the minimum size limits, constraining the harvest of Sacramento River winter-run Chinook salmon and Klamath River fall-run Chinook salmon. Existing inland fishing regulations protect a portion of spring-run adults from harvest, but allows a limited level of exploitation in the Sacramento River downstream of Deschutes Bridge, and in the Feather River downstream of the Highway 70 Bridge. Fishing regulations in tributaries such as Mill, Deer, and Antelope creeks permit seasonal angling but do not allow harvest of salmon.

Although protective measures have likely led to recent increases in spring-run Chinook salmon abundance, the ESU is still below levels observed from the 1960s through 1990. Threats from hatchery production, climatic variation, predation, and water diversions persist. Although some metapopulations have recently declined, others, such as the Butte Creek population, have increased substantially. The existence of several metapopulations has aided the recent stability of the spring-run Chinook salmon ESU, however, the number of metapopulations is considerably reduced from historic conditions and while they continue to display broad fluctuations in abundance, the ESU will remain at a moderate risk of extinction.

3. Central Valley Steelhead

The factors affecting the survival and recovery of steelhead are similar to those affecting winter- and spring-run Chinook salmon and are primarily associated with habitat loss (McEwan 2001). McEwan and Jackson (1996) attribute this habitat loss and other habitat problems primarily to water development resulting in inadequate flows, flow fluctuations, blockages, and entrainment into diversions. Other habitat problems related to land use practices and urbanization have also contributed to steelhead declines (Busby *et al.* 1996). Although many of the factors affecting salmon are common to steelhead, some stressors, especially summer water temperatures cause greater effects to steelhead since juvenile steelhead rear in freshwater for more than one year. Suitable steelhead conditions primarily occur in mid to high elevation streams. Because most of the suitable habitat has been lost to dam construction, juvenile rearing is mostly confined to lower elevation reaches where water temperatures during late summer and early fall can be high.

Many of the habitat improvements that have benefitted winter-and spring-run Chinook salmon, including water management through the CVPIA b(2) water supply and the CALFED EWA, improved screening conditions at water diversions, and changes in inland fishing regulations benefit steelhead, however, many dams and reservoirs in the Central Valley do not have water storage capacity or release mechanisms necessary to maintain suitable water temperatures for steelhead rearing through the critical summer and fall periods, especially during critically dry years (McEwan 2001). The future of steelhead is uncertain because of the lack of trend data, but is thought to be at a moderate risk of extinction because, although the ESU is comprised of several metapopulations, the overall abundance of the ESU may still be declining.

IV. ENVIRONMENTAL BASELINE

The environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species within the action area (*i.e.,* from 450 feet upstream to 500 feet downstream of the Cypress Avenue bridge). The environmental baseline "includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process" (50 CFR §402.02).

A. Status of listed species and critical habitat within the action area

The action area provides spawning habitat for winter- and spring-run Chinook salmon, and steelhead. The action area also functions as a migratory corridor for adult and juvenile winter- and spring-run Chinook salmon and steelhead, and as juvenile rearing habitat for winter- and spring-run Chinook salmon and steelhead. Due to the life history timing of winter- and spring-run Chinook salmon, and steelhead, it is possible for one or more of the following life stages: adult migrants, spawners, incubating eggs, or rearing and emigrating juveniles to be present throughout the year.

1. Status of Species

Reliable estimates of the number of winter- and spring-run Chinook salmon and steelhead adults and juveniles within the action area are not available; however, general Chinook salmon redd abundance and spawning distribution for winter-and spring-run Chinook salmon can be determined through DFG aerial redd surveys. DFG conducts monthly aerial redd surveys of the upper Sacramento River from the Ord Ferry Bridge to Keswick Dam from May through April of each year. These surveys indicate that the action area is within the primary spawning range of winter- and spring-run Chinook salmon. From 1995 through 2002, the percentage of winter-run Chinook salmon redds in the survey reach which contains the Cypress Avenue bridge *(i.e.,* Highway 44 bridge to Airport Road bridge) has ranged from 9 to 65 percent of the total winter-run redd count and has averaged approximately 30 percent over that time period. The percentage of spring-run Chinook salmon redds found in this reach from 1995 through 2002 has ranged from 7 to 100 percent of the total mainstem Sacramento River spring-run Chinook salmon redd count, and has averaged approximately 37 percent over that time period. A review of DFG's aerial survey maps indicates that both winter-and spring-run Chinook salmon spawning does occur in the action area, although not every year. When spawning does occur within the action area, the number of redds is usually less than one percent of the total Sacramento River redd count for each race. No other recent information on winter- and spring-run Chinook salmon presence, distribution, or absence exists for the action area.

In addition to the spawning habitat within the action area, the diversity of other habitat types contribute to important rearing conditions. Pools, riffles, shallow water margins, and nearshore brushy riparian vegetation provide essential juvenile rearing components including slow water refugia, turbulent overhead cover, and aquatic insect production.

2. Status of Critical Habitat

The flows in the upper Sacramento are regulated by releases from Keswick and Shasta Dams. Summer releases are closely managed to meet water temperature objectives for spawning winter- and spring-run Chinook salmon and to provide water for irrigation. From May through August Keswick releases average approximately 12,000 cfs and water temperatures are held at or below 56 °F. Releases are reduced from September through December and under dry conditions can often drop to between 5,000 and 4,000 cfs. Flow reductions of this magnitude have been found to dewater salmonid redds built along the shallow margins and point bars throughout the upper river (Doug Killam, DFG, pers. comm. 2002). January, February, and March have the greatest probability of high flows, but they can also have some of the lowest flows of the year depending on the amount and timing of precipitation and available storage behind Shasta Dam. In dry years winter flows in the action area are frequently held below 4,000 cfs and can potentially go as low as 3,250 cfs. Again, if salmonid redds are built under higher flow conditions (either earlier in the year or during weather related flow peaks), large, sustained flow reductions can cause the dewatering of redds built in shallow water.

The riverine habitat within the action area includes the Sacramento River and Calaboose Creek, a narrow (4- to 6-foot wide) channelized, intermittent drainage located northwest of Cypress Avenue. The Sacramento River flows through a moderately confined channel dominated by run and riffle habitats, with mainly boulder, cobble, and large gravel substrates. Vegetation within the river is sparse, however, submergent and emergent species such as white-water buttercup *(Ranunculus aquatilis*) and rushes occupy stream margins and backwater areas. Calaboose Creek, within the action area, is channelized, with steep banks on either side. Vegetation along this drainage consists of exotic and native plants.

Valley-foothill riparian habitat dominates the river margins throughout much of the action area with the exception of the area directly under the bridge which is generally devoid of most vegetation. The dominant species in the canopy layer of the riparian zone include Fremont cottonwood (*Populus fremontii*), valley oak (*Quercus lobata*), and black locust *(Robinia pseudoacacia*). Sub-canopy trees include white alder (*Alnus rhombifolia*), and Oregon ash (*Fraxinus latifolia*). Understory vegetation includes, lianas of wild grape *(Vitis californica*), dense thickets of California blackberry *(Rubus ursinus)*, exotic Himalayan blackberry *(Rubus discolor)*, and several species of willow *(Salix spp.)*. The forb herbaceous layer consists of rushes *(Juncus* sp.), sedges *(Carex* sp.), and Douglas sagewort *(Artemisia douglasia)*.

Section 3406(b)(13) of the CVPIA requires the Bureau of Reclamation to restore and replenish spawning gravel, and re-establish meander belts in rivers. To meet these requirements in the upper Sacramento River, spawning gravel augmentation projects have placed suitable spawning substrate into various locations in the Sacramento River. In 2000, BOR placed 39,000 tons of clean washed spawning gravel into the river below Keswick Dam. Other construction projects have compensated for adverse effects to salmonids using spawning gravel augmentation.

Snorkel surveys of the Sacramento River channel were conducted within an identified study area that encompasses 600 feet upstream and 600 feet downstream of the existing Cypress Avenue bridge, on April 27, 2001. When feasible *(i.e.,* where current velocity and depth allowed), spawning areas were measured with a measuring tape and located on aerial photographs. The spawning habitat criteria used for Chinook salmon during this survey were based on descriptions used by the FWS, as follows:

Good: Substrate predominantly composed (approximately 90 to 100 percent) of gravel and cobble ranging in size from 1 to 6 inches with most substrate 2 to 4 inches.

Fair: Substrate predominantly composed (approximately 50 to 90 percent) of gravel and cobble. Substrates generally larger than optimal size for salmon spawning with a greater abundance of cobble.

Poor: Substrate composed almost entirely of larger cobbles or of gravels with a large amount of fines present.

For the Cypress Avenue Bridge Replacement project study, substrate categories between 1 to 4 inches diameter were used to describe suitable spawning habitat conditions for steelhead trout and areas of gravel that were less than 100 square feet *(i.e.,* 10 feet by 10 feet) were not considered suitable for any species.

A total of 7.245 acres of spawning habitat suitable for either salmon or steelhead or both was identified within the approximately 13.25-acre study area that extended 600 feet upstream and 600 feet downstream of the existing Cypress Avenue Bridge structures. Any substrate that met the Good, Fair, or Poor criteria was considered potentially suitable spawning habitat for salmonids, regardless of flow velocities during the time of the survey. Approximately 90 percent of the suitable habitat was located downstream of Cypress Avenue.

B. Factors affecting species and critical habitat within the action area

The factors affecting the species and critical habitat within the action area include river flows, water temperatures, spawning gravel suitability, water quality, interactions with other species, and the quality and abundance of riparian habitat. River flow and temperature criteria were established in the winter-run opinion, which led to the construction of the TCD, and have resulted in improved river flow and temperature management. Although these criteria were developed to meet winter-run Chinook salmon needs, spring-run Chinook salmon and steelhead also have benefitted. Gravel augmentation has resulted in localized areas of good quality spawning gravel. Riparian conditions provide limited shade, and large woody debris recruitment because the existing riparian habitat is comprised primarily of small diameter brush, and does not form a canopy over the river.

Ongoing improvements to the Sacramento River in the vicinity of Redding including gravel augmentation, screening of diversions and riparian habitat restoration are expected to further improve conditions for anadromous fish and critical habitat, but the incremental benefit of these actions is not yet known. Even with these improvements, some problems persist that may affect anadromous fish within the action area. Some of the remaining problems include episodic discharges of heavy metals from the Superfund Iron Mountain Mine site, major fall and winter flow reductions causing dewatering of redds, potential competition and genetic introgression between spring- and fall-run Chinook salmon due to overlapping spawning habitats, and degraded rearing conditions in the river due to a lack of riparian habitat.

The frequency of acid mine drainage exceeding target levels below Keswick Dam has decreased over the last ten years, however, exceedences of dissolved copper targets have occurred during each of the last six years, and metal concentrations remain high enough to have sublethal effects on adult fish and lethal effects on eggs and larvae (Regional Board 2001). Although acid mine drainage has, over the years, reduced the number of Chinook salmon and steelhead within the action area, recent remedial actions at Iron Mountain Mine, probably have curtailed the loss of individuals.

Fall flow reductions have been found to cause extensive redd dewatering throughout the Sacramento River spawning areas (Doug Killam, DFG, pers. comm. 2002). The largest reductions have been occurring in early to mid-November, following the peak in water demand for rice decomposition. While reductions in this time period primarily impact fall-run Chinook salmon, they also have the potential to impact late spawning spring-run Chinook salmon and early spawning steelhead.

The construction of Shasta and Keswick Dams, and the resultant exclusion of spring-run Chinook salmon from their historic upper Sacramento River spawning habitat has forced mainstem-spawning spring-run Chinook salmon to spawn in the middle reaches of the river (between Keswick and Red Bluff Dams) in areas easily accessible to fall-run Chinook salmon. Because spring-run Chinook salmon hold over the summer and spawn during a similar time period as do fall-run Chinook salmon (September through October depending on habitat conditions), there is a potential for the two races to have negative interactions such as competition for prime spawning sites, superimposition of redds in the same location and genetic introgression caused by individuals of the different races spawning together and creating crossed progeny.

C. Likelihood of species survival and recovery in the action area

Winter- and spring-run Chinook salmon and steelhead are expected to continue to utilize the action area as a migratory corridor, and for spawning and rearing. The value of the action area as a migratory corridor, and despite its relatively small size, its suitability as spawning and rearing habitat, make it an important node of habitat for the survival and recovery of local populations. Because the action area is within the most important habitat available to winter-run Chinook salmon, the continuity and connectivity of the action area to the rest of this habitat is important for the survival and recovery of that ESU. Although the habitat within the action area may be important for the survival and recovery of local populations of spring-run Chinook salmon and steelhead, the distribution of these species throughout the geographical range of the ESU, and their primary abundance in other streams and rivers, means that the value of the habitat within the action area may not be essential for the survival and recovery of spring-run Chinook salmon and steelhead.

V. EFFECTS OF THE ACTION

Pursuant to Section 7(a)(2) of the ESA (16 U.S.C. §1536), Federal agencies are directed to ensure that their activities are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. This biological opinion assesses the effects of the Cypress Avenue Bridge Replacement project on Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead. The Cypress Avenue Bridge Replacement project is likely to adversely affect listed species through temporary construction impacts and short and long term habitat alteration. In the *Description of the Proposed Action* section of this Opinion, NOAA Fisheries provided an overview of the action. In the *Status of the Species* and *Environmental Baseline* sections of this

Opinion, NOAA Fisheries provided an overview of the threatened and endangered species and critical habitat that are likely to be adversely affected by the activity under consultation.

Regulations that implement section 7(b)(2) of the ESA require biological opinions to evaluate the direct and indirect effects of Federal actions and actions that are interrelated with or interdependent to the Federal action to determine if it would be reasonable to expect them to appreciably reduce listed species' likelihood of surviving and recovering in the wild by reducing their reproduction, numbers, or distribution (16 U.S.C. §1536; 50 CFR 402.02). Section 7 of the ESA and its implementing regulations also require biological opinions to determine if Federal actions would appreciably diminish the value of critical habitat for the survival and recovery of listed species (16 U.S.C. §1536; 50 CFR 402.02).

NOAA Fisheries generally approaches "jeopardy" analyses in a series of steps. First, we evaluate the available evidence to identify the direct and indirect physical, chemical, and biotic effects of proposed actions on individual members of listed species or aspects of the species' environment (these effects include direct, physical harm or injury to individual members of a species; modifications to something in the species' environment - such as reducing a species' prey base, enhancing populations of predators, altering its spawning substrate, altering its ambient temperature regimes, or adding something novel to species' environment - such as introducing exotic competitors or disruptive noises). Once we have identified the effects of an action, we evaluate the available evidence to identify a species' probable response (including behavioral responses) to those effects to determine if those effects could reasonably be expected to reduce a species' reproduction, numbers, or distribution (for example, by changing birth, death, immigration, or emigration rates; increasing the age at which individuals reach sexual maturity; decreasing the age at which individuals stop reproducing; among others). We then use the evidence available to determine if these reductions, if there are any, could reasonably be expected to appreciably reduce a species' likelihood of surviving and recovering in the wild.

A. Approach to the Assessment

1. Information Available for the Assessment

To conduct this assessment, NOAA Fisheries examined an extensive amount of information from a variety of sources. Detailed background information on the status of these species and critical habitat has been published in a number of documents including peer reviewed scientific journals, primary reference materials, government and non-government reports, the biological assessment for this project, and project meeting notes.

2. Assumptions Underlying This Assessment

In the absence of definitive data or conclusive evidence, NOAA Fisheries will make a logical series of assumptions to overcome the limits of the available information. These assumptions will be made using sound scientific reasoning that can be logically derived from the available data. The progression of the reasoning will be stated for each assumption, and supporting evidence will be sited.

B. Assessment

The proposed project includes actions that may adversely affect several life stages of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead. Adverse effects to listed salmonids and critical habitat may result from changes in water quality from construction activities, loss of riparian vegetation from construction activities, and damage to incubating eggs and harassment of juvenile and adults from pile driving and gravel pad installation. The project includes integrated design features to avoid and minimize many potential impacts.

1. Water Quality

In-river construction and demolition work may increase suspended sediments and elevate turbidity above natural levels. Activities that could contribute suspended sediment and increase turbidity include sheet and steel pile driving and removal, placement and removal of gravel approach pads, removal of existing piers, and use of access roads and near-river staging areas. Turbidity increases will be limited to 10 to 20 percent above natural levels. Water quality may also be affected by hydraulic and fuel line leaks and petroleum spills. NOAA Fisheries expects that the risk of introducing petroleum products or pollutants other than sediment to the waterway will be sufficiently minimized because prevention and contingency measures will require frequent equipment checks to prevent leaks, will keep stockpiled materials away from the water, and will require that absorbent booms are kept onsite to prevent petroleum products from entering the river in the event of a spill or leak.

High turbidity affects salmonids by reducing feeding success, causing avoidance of rearing habitats, and disrupting upstream and downstream migration. Displacement of juveniles from preferred habitats may increase the susceptibility of juveniles to predation. Bisson and Bilby (1982) reported that juvenile coho salmon avoid turbidities exceeding 70 NTUs, and Sigler *et al* (1984) in Bjornn and Reiser (1991) found that turbidities between 25 and 50 NTUs reduced growth of juvenile coho salmon and steelhead. Turbidity should affect Chinook salmon in much the same way it affects juvenile steelhead and coho salmon because of similar physiological and life history requirements between the species. Increased sediment delivery and high levels of sediment transport also can cause scour of incubating embryos, infiltration of fine sediment into spawning gravels, decreased substrate permeability and intergravel flow and, ultimately, lead to reductions in the numbers of emergent salmonid fry (Lisle and Eads 1991). Increased sediment delivery can also fill interstitial substrate spaces and reduce abundance and availability of aquatic invertebrates for food (Bjornn and Reiser 1991).

Effects of project-related turbidity and introduction of sediment to the Sacramento River water could affect the behavior, growth, and migration of listed salmonids in the action area. Adherence to the preventative and contingency measures of the SWPPP will minimize project related-sediment plumes caused by in-river construction by removing excavation materials to locations outside of the river channel and halting work in the event of a plume detection, and will minimize the amount of project-related sediment introduced to the waterway through the use of silt fences, straw mulch, erosion control seeding, and clean, washed approach pad substrates. In the event that a sediment plume does occur, it would be of short duration, since work would be suspended, and would be expected to result in a temporary change in the distribution of the species in the action area, lasting only as long as the plume was present.

These types of events are unlikely to affect migrating adults to the extent of injuring them, but may injure some juvenile salmonids, which are actively feeding and growing, as well as smaller and less mobile, by temporarily disrupting normal behaviors that are essential to growth and survival. Injury would be caused when disrupting these behaviors increases the likelihood that individual fish will face increased competition for food and space, and experience reduced growth rates or possibly weight loss. Project-related turbidity increases may also affect the sheltering abilities of some juvenile salmon and steelhead and may decrease their likelihood of survival by increasing their to the susceptibility to predation. However, because of the short duration of the turbidity events and the avoidance of peak migration periods through the implementation of in-water construction windows, few individuals are expected to be affected. Therefore, the injury and death that will occur to juvenile salmon and steelhead from changes in feeding behavior, distribution, and predation, are not expected to result in changes to listed anadromous populations.

2. Riparian Habitat

Riparian vegetation adjacent to the river, including SRA habitat, is a component of designated critical habitat for winter-run Chinook salmon. Riparian habitat is an important component of critical habitat because it provides cover, shelter, shade, and contributes to food production (Platts 1991).

Construction activities associated with the proposed Cypress Avenue Bridge Replacement project would result in both temporary and permanent impacts to SRA habitat. Up to 0.045 acre of riparian vegetation and SRA habitat would be permanently lost as a result of constructing the widened bridge structure, whereas temporary access routes and staging would result in the temporary loss of 0.615 acre of riparian habitat.

Removal of riparian habitat will affect winter- and spring-run Chinook salmon and steelhead by reducing the amount of overhanging and submerged vegetation, and consequently the amount of cover available for fish, and the food supply provided when terrestrial insects fall into the river from overhanging vegetation. Removal of riparian vegetation is not expected to affect water temperature because the extent of shade is not sufficient to overcome the effects of water temperature controlled through cold water releases from Shasta Reservoir.

The project has been be designed to avoid and minimize losses to riparian vegetation adjacent to the river channel. Mature cottonwood trees located near construction areas will be flagged and avoided during construction to the fullest extent possible. In addition, exclusionary fencing shall be installed within all riparian areas in which construction access would have to occur to ensure that impacts to riparian vegetation are minimized. When loss of riparian vegetation along the river is unavoidable, the City will restore riparian vegetation at a ratio of 3:1 for each woody riparian plant and/or linear feet of SRA habitat removed due to project construction (either temporary construction access or permanent loss associated with new piers).

The City has developed a riparian revegetation plan to address impacts to SRA habitat that occur during project construction. The revegetation plan identifies appropriate mitigation for impacts, describes planting techniques and locations, and incorporates planting of native species that would resist invasion of noxious plant species. All temporary impacts to riparian habitat would be mitigated on site, within the areas disturbed as a result of construction activities (*i.e.*, construction access routes, materials staging, *etc.*). If permanent impacts to riparian vegetation cannot be mitigated on site, the City will purchase up to 0.135 acre (3 x 0.045 acre of riparian wetland) of riparian mitigation at DFG's Battle Creek Riparian Mitigation Site, which is located approximately 18 miles southeast of the project site.

The reduction of riparian habitat will affect species utilizing the action area for ten to twenty years following construction, or until the vegetation conditions can become re-established. Willows and low shrubs will revegetate most quickly and may contribute to fish habitat in fewer than ten years, however, the larger trees such as cottonwoods and oaks that contribute the large woody component of SRA may take more than twenty years to be replaced. Since the area is dominated by shrubs and willows, most of the existing habitat features should be replaced within ten years. Juvenile salmonids utilizing the action area during this recovery period may be injured from the reduced levels of overhead cover and food supply. Because of the small size of the affected area, the abundance of other forms of overhead cover and shade *(e.g.,* pools, riffles and the bridge itself), and adequate aquatic food production, few individuals are expected to be affected. Therefore, it unlikely that the proposed reduction in riparian habitat will result in changes to listed anadromous populations.

3. Loss of Potential Spawning Habitat

Based on the April 27, 2001 salmonid spawning habitat assessment, suitable substrate was identified within areas that would be disturbed due to the bridge replacement activities. The proposed bridge replacement would result in only four piers being located within the floodplain, as opposed to the seven piers associated with the existing bridge structure. This may result in a long term beneficial impact by creating new areas in which suitable spawning substrates could become established.

Anti-spawning mats will be installed as far as 450 feet upstream and downstream from any proposed pile-driving activities. This would leave approximately 5.7 acres of suitable spawning substrate unavailable for use as spawning habitat by Chinook salmon and steelhead from April 15 through October 15, for up to three construction seasons. The general life history of Sacramento River Chinook salmon is such that most fish return to spawn as three-year-olds. Therefore there are three semi-distinct year classes which together make up the entire population Chinook salmon. The three year construction period for this project insures that each year class will experience this loss of potential spawning habitat one time, but no single year class, or segment of the population, will be impacted more than once.

A 1980 survey of spawning sites available between Keswick Dam and Red Bluff Dam, indicated that there were approximately 96,000 sites available (DFG 2001). Based on the large number of potential spawning sites and the relatively small number of returning winter and spring-run Chinook salmon at this time (generally between 1,000 and 10,000 adults over the last five years; Table 1), the one-time loss of this small amount of potential spawning habitat is not expected to significantly impact spawning fish or appreciably reduce the reproductive success of winter- or spring-run Chinook salmon or steelhead.

4. Pile Driving and Bridge Demolition

Pile driving consists of driving steel pile columns and sheets into the riverbed with a mechanical hammer. The force of the hammer hitting a pile forms a sound wave that travels down the pile and causes the pile to resonate radially and longitudinally. Acoustic energy is formed as the walls of the steel pile expand and contract, forming a compression wave that moves through the pile. The outward movement of the pipe pile wall sends a pressure wave propagating outward from the pile and through the riverbed and water column in all directions. Demolition of the existing piers will require the use of a hoe-ram to break up the concrete into manageable pieces for removal. The energy generated by the hoe-ram is typically much less than a pile-driving hammer, by a factor of 10. For instance, the driving energy for a steel pile driver is approximately 75,000 ft-lbs, whereas the hoe-ram delivers around 7,500 ft-lbs of energy.

The effect of pile driving on fish depends on the duration, frequency (Hz), and pressure (dB) of the compression wave. Salmonids hear within a range of 10 to 400 Hz, with the greatest sensitivity between 180 and 190 Hz (Feist *et al* 1992). Rassmusen (1967) found that immediate mortality of juvenile salmonids may occur at sound pressure levels exceeding 204 dB. Due to their size, adult salmon and steelhead can tolerate higher pressure levels and immediate mortality rates for adults are expected to be less than those experienced by juveniles (Hubbs and Rechnitzer 1952). Burner and Moore (1962) found that large juvenile and adult fish rarely respond to sudden or loud sound stimuli. However, experiments by Mckinley and Patrick (1986) using pulsed sound (similar to pile driving), found that smaller juvenile fish demonstrated a startle or avoidance response.

Feist *et al* (1992) found that pile driving in Puget Sound created sound within the range of salmonid hearing that could be detected at least 600 m away. Abundance of juvenile salmon near pile-driving rigs was reduced on days when the rigs were operating compared to non-operating days. Pile driving may result in "agitation" of salmonids indicated by a change in swimming behavior (Shin 1995). This suggests that pile driving may cause avoidance of habitat in the immediate vicinity of the project site.

The range and intensity of a compression wave is related to the size of the hammer and the medium through which the wave travels. Large hammers will result in high pressures, or decibels, and dense mediums will result in effective transmission of compression waves. Small hammers will result in low pressures and inconsistent mediums (mediums with variable or changing densities) will result in transmission loss, or attenuation, of the wave. The pressure of a compression wave will decrease with distance and the range of the wave will decrease in proportion to the rate of transmission loss.

Because inconsistent mediums, such as water, will result in a higher rate of transmission loss, environmental factors such as water depth, water turbulence, air bubbles, and substrate consistency are important to consider when estimating the distance a compression wave will travel. A compression wave traveling through shallow water and substrates with variable consistencies (variable particle size class distribution) will attenuate more rapidly than compression waves traveling through a constant medium such as deep water or bedrock. As a compression wave moves away from the source, the wave length increases and intersects with the air/water interface. Once the compression wave contacts the air, it attenuates rapidly and does not return to the water column.

Since little is known about the effects of compression shock waves on fish eggs incubating within a gravel matrix, the effect of pile driving on salmon and steelhead eggs is less clear. Salmon and steelhead eggs are very fragile, and thus susceptible to mechanical shock prior to the eyed egg stage (Jensen and Alderice 1983, Piper *et al* 1982). During this period of development, high pressure compression shock waves may cause egg mortality in redds that are close to pile-driving activities.

At the City of Sacramento Water Treatment Plant Fish Screen project, engineering analysis anticipated sound pressure levels from pile driving would reach 95 to 120 dB, capable of startling salmonids, but not sufficient to cause lethal or sublethal effects. In planning for the replacement of the Diestelhorst bridge in Redding California, engineering analysis concluded that driving small piles would adversely affect salmon and steelhead eggs for up to 150 feet, and large "H" pile driving would adversely affect eggs for up to 450 feet away from the sound pressure source (Harry Rectenwald, DFG, pers. comm. 2002). In order to determine these distances at Diestelhorst, Caltrans engineers used the static and oscillating pressure thresholds for salmon eggs identified by Sutherland and Ogle (1975). These thresholds were initially recognized through evaluating the effects of jet boats on salmon eggs, and were considered applicable for evaluating the effects of pile driving because they are based on sound pressure.

Although there are few similarities in river characteristics between the Sacramento Water Treatment Plant Fish Screen project site and the Cypress Avenue Bridge Replacement project site, effects to salmonids are expected to be similar, if not less at the Cypress Avenue bridge site because the shallower, faster, more turbulent water at Cypress Avenue bridge would attenuate sound effects more readily. Due to similarities in river and substrate conditions between the Cypress Avenue bridge and the Diestelhorst bridge, including substrate, water depth, velocity, and turbulence, sound effects from pile driving should be similar.

After considering the environmental variables at the project site, the physical behavior of compression shock waves, and the life history of listed salmonids in the action area, adult and juvenile winter-run Chinook salmon, spring-run Chinook salmon, and steelhead are expected to experience startle responses and temporary interruption of migration or rearing as a result of pile-driving and demolition activities. NOAA Fisheries anticipates that these activities will be detectable to juvenile and adult salmonids up to 600 m from the source. Adult winter-run Chinook salmon spawning peaks in May and June, and adult spring-run Chinook salmon spawning peaks in September. These primary spawning periods overlap with the period that pile driving will occur *(i.e.,* April 15 to October 15). Adults in the action area that physiologically are ready to spawn and experience delays in reaching preferred spawning habitat due to pile-driving activities may be injured if their reproductive success is impaired *(e.g.,* from spawning in lower quality habitat).

The startling of juvenile salmonids is expected to cause injury by temporarily disrupting normal behaviors that are essential to growth and survival such as feeding, sheltering, and migrating. Injury is caused when disrupting these behaviors increases the likelihood that individual fish will face increased competition for food and space, and experience reduced growth rates or possibly weight loss. Disruption of these behaviors may also result in the death of some individuals to increased predation if fish are disoriented or concentrated in areas with high predator densities. Disruption of these behaviors will occur between April 15 and October 15 of each construction year, during daylight operation hours of the hydraulic hammer. Downstream movement of fry occurs mainly at night, although small numbers of Chinook salmon fry move during daylight hours (Reimers 1971). Because of this nocturnal migratory behavior, daily migration delays are expected only to impact the portion of each ESU that migrates during daylight hours. On similar bridge projects, such as the replacement of the I-5 bridge over the Sacramento River near Anderson, lapses in pile-driving activity are common throughout the day because construction crews suspend hammer work for equipment maintenance, to shift from one pile to another, and to take breaks (D. Whitley, Caltrans, pers. comm., 2002). These construction lapses, including daily breaks and nighttime non-working periods will allow fish to migrate through the action area and minimize the extent of injury that occurs to populations.

The population-level effects of harassment to adult and juvenile Chinook salmon and steelhead are expected to be limited in part because pile driving will occur during the day, enabling unhindered fish passage at night. Also, the April 15 through October 15 work window will avoid the peaks of migration periods except for winter-run Chinook salmon juveniles and spring-run Chinook salmon adults. The outmigration period for winter-run Chinook salmon juveniles is extended *(i.e.,* from July through March in some years), which should allow many individuals to pass through the action area outside of the in-water work window. Many subpopulations of Central Valley spring-run Chinook salmon occurring in tributaries to the Sacramento River (*e.g.*, Deer and Mill Creeks) are not required to pass through the action area at all.

If pile-driving activities occur between October 15 and April 15, spring-run Chinook salmon and steelhead eggs deposited within 450 feet of "H" pile driving and within 150 feet of sheet and small pile driving are expected to die. However, the maintenance of anti-spawning mats through October 15 is likely to prevent the spawning of spring-run Chinook salmon within the project area as the primary spawning period for spring-run Chinook salmon runs from August 15 through October 15 (Vogel and Marine 1991). Additionally, the stipulation that no pile driving will be permitted between October 15 and April 15 if spawning activity is detected within 450 feet of the bridge (see section //. *B. 2. Percussion Impacts to Incubating Salmonid Embryos)* is expected to further reduce the potential for impacts to spring-run Chinook salmon and steelhead eggs. Winter-run Chinook salmon eggs are not expected to be deposited within the pile-driving impact zone due to the placement of anti-spawning mats within this zone throughout the spawning period.

5. Cofferdams

Closure of cofferdams may entrap winter-run Chinook salmon, spring-run Chinook salmon, and steelhead juveniles. The timing of cofferdam closure could correspond with the end of the winter-run Chinook salmon migration, and will take place during spring-run Chinook salmon and steelhead rearing and emigration. The cofferdam installation process will probably startle most of the salmon near the construction site and cause them to leave the immediate area of work; however, it is possible that some fish will be entrained when the coffer is closed. Any fish that are left within the cofferdam would be expected to die when the coffer is pumped dry. Conducting a fish salvage in closed cofferdams will reduce the mortality associated with pumping. Any fish recovered from a cofferdam would be relocated downstream. A small mortality rate (probably less than 10 percent when compared to the fish handling of other fish salvage efforts) is expected from capturing and handling. Population-level effects of mortality due to entrainment ofjuvenile salmonids are not anticipated because few individuals are expected to be entrained, and less than 10 percent of these fish are expected to die.

6. Fish Passage

The combination of cofferdams and the gravel approach pads occupying space in the river will reduce the width of the river and increase water velocities. An increase in water velocities will not prevent juveniles from passing downstream to rear, but could hinder the upstream migration of adult salmon. The contractor will maintain at least 500 feet ofunconfined river flow through the project area. At the I-5 Bridge Replacement project near the City of Anderson, the gravel work pad and cofferdams have constricted the channel width to approximately 100 feet. This constriction apparently has not resulted in velocities capable of preventing the upstream migration of adult salmon and steelhead because in 2001, 98.8 percent of winter-run Chinook salmon and 68.6 percent of fall-run Chinook salmon spawned upstream of the I-5 Bridge Replacement project. These spawning distributions are similar to previous years, prior to the construction period. Because replacement techniques at the Cypress Avenue bridge will maintain a greater width of unconfined channel, and are expected to result in similar or less restrictive flow conditions as those found at the I-5 bridge, no effects to fish passage, other than the potential delays related to pile driving and other sounds are anticipated.

VI. CUMULATIVE EFFECTS

For purposes of the ESA, cumulative effects are defined as the effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within an action area of the Federal action subject to consultation (50 CFR 402.02). Future Federal actions are not included here because they require separate consultation pursuant to section 7 of the ESA.

Non-federal actions that may affect the action area include population changes, urbanization, and habitat restoration. During the period of 1980 to 1990 the population of Redding increased by 27 percent, and from 1990 to 2000 increased by 11 percent. For the next twentyfive years, the projected population increase for the Redding area is expected to be 29.9 percent. Increased development is expected to occur concurrent with Redding's population expansion. Population growth and urbanization may adversely affect water quality in the action area as the amount of impervious surface area increases, resulting in peaking hydrographs of contaminated urban runoff.

It is difficult to predict the effect that these actions will have on listed salmonids. Habitat restoration will probably continue to improve conditions for salmonids by increasing their range, distribution, and natural production; however the effectiveness of restoration in offsetting the adverse effects related to urban growth are not fully known.

VII. INTEGRATION AND SYNTHESIS OF EFFECTS

NOAA Fisheries finds that the project proponent will take steps to avoid impacts to spring- and winter-run Chinook salmon incubating eggs by placing and maintaining anti-spawning mats over all suitable spawning habitat within the pile-driving impact zone throughout the primary spring-run and winter-run Chinook salmon spawning period (April 15 through October 15). Adverse effects to steelhead redds will be minimized by deferring any winter pile-driving activities if inspection by a qualified fishery biologist detects spawning activity within the impact zone. Since the end of steelhead spawning and incubation may overlap with the April 15 installation of the anti-spawning mats and commencement of pile driving, the potential exists for a small number of steelhead redds to be impacted by these activities. Some juvenile anadromous fish may be entrained into cofferdams when they are closed. Those fish which are entrained within these cofferdams would have a high probability (> 90 percent) of survival due to planned fish salvage efforts. Pile driving, gravel approach pad installation, and demolition of the existing bridge are likely to harass adult and juvenile winter-run Chinook salmon, spring-run Chinook salmon, and steelhead. Effects to all listed anadromous species stemming from loss of riparian vegetation, and other construction activities that may contribute sediment and increase turbidity will be further avoided or minimized by meeting Regional Board water quality objectives, Caltrans water pollution specifications, implementing applicable BMPs, staging equipment outside of the riparian corridor, limiting the amount of riparian vegetation removal, and replacing lost riparian vegetation at the project site or at the Battle Creek mitigation site.

The most likely effects to listed salmonids, resulting from the proposed action, are harassment of adult and juvenile winter-run Chinook salmon, spring-run Chinook salmon, and steelhead resulting from the noise of pile driving, and entrainment of juveniles into cofferdams. Harassment is expected to result in temporary disruptions in the migratory behavior of adult and juvenile salmonids but not prevent these fish from passing upstream or downstream. Entrainment-related effects will be minimized through fish salvage. The possibility of egg mortality exists, but is expected to be low and will only occur if listed salmonids manage to spawn near the construction site.

A. Impacts of the proposed action on critical habitat

The project will result in the permanent loss of approximately 0.045 acre of riparian and wetland vegetation and the temporary disturbance of an additional 0.615 acre of riparian habitat, as well as temporary occupation of the riverbed and water column by cofferdams, work trestles and gravel approach pads. Temporary losses of critical habitat in the river channel will affect anadromous species by reducing onsite rearing and spawning habitat. However, implementation of the proposed project would result in a permanent net increase of riverine habitat because this project would result in three fewer piers being located within the floodplain.

The temporary impacts to riparian vegetation at the project site will last for approximately ten to twenty years. Revegetating the project site and an additional 0.135 acre offsite will quickly offset the adverse effects of removing annual plants; however, habitat attributes related to the replacement of large woody vegetation will not be realized for much longer. Placement of anti-spawning mats and construction of the gravel approach pads will affect critical habitat by covering and altering the hydrology of suitable spawning habitat for three years, but the remaining gravel will ultimately improve spawning within the action area following the construction period as gravels which are left in the river are redistributed and made available to spawning fish.

These effects to critical habitat may result in a temporary redistribution of some individuals, primarily spawning adults and rearing juvenile winter- and spring-run Chinook salmon and steelhead, but due to the temporary nature of these effects and the long-term improvement expected from revegetating the project site and increasing the amount of spawning gravel in the action area, these effects will not appreciably diminish the value of critical habitat for supporting the survival and recovery of winter- and spring-run Chinook salmon and steelhead.

B. Impacts of the proposed action on ESU survival and potential for recovery

The adverse effects to Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead within the action area are not expected to affect the overall survival and recovery of the ESUs. This is largely due to the fact that the construction-related impacts will be temporary and will not impede adult fish from reaching upstream spawning and holding habitat, or juvenile fish from migrating to downstream rearing areas, and because egg mortalities from pile driving will be minimized by taking measures to reduce the suitability of the action area for spawning. The number of individuals actually injured or killed is expected to be small compared to the sizes of the respective salmonid populations; therefore, population-level impacts are not anticipated. Additionally, the project will compensate for temporary losses of riparian vegetation, and spawning habitat in the action area will ultimately be improved through the introduction of clean, washed gravel. The bridge replacement design will eventually result in a smaller area of river-bed occupied by the bridge footprint and therefore provide a greater amount of habitat available to salmon than is currently available with the existing bridge.

VIII. CONCLUSION

After reviewing the best available scientific and commercial information; the current status of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, and the designated critical habitat of Sacramento River winter-run Chinook salmon; the environmental baseline for the action area; the effects of the proposed action; and the cumulative effects, it is NOAA Fisheries' biological opinion that the Cypress Avenue Bridge Replacement project, as proposed, is not likely to jeopardize the continued existence of the Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, and is not likely to destroy or adversely modify the designated critical habitat Sacramento River winter-run Chinook salmon.

IX. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by NOAA Fisheries as an act which kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by FHWA and Caltrans so that they become binding conditions of any grant or permit, as appropriate, for the exemption in section 7(o)(2) to apply. FHWA has a continuing duty to regulate the activity covered by this incidental take statement. If FHWA (1) fails to assume and implement the terms and conditions of the incidental take statement or (2) fails to require Caltrans to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, Caltrans must report the progress of the action and its impact on the species to the NOAA Fisheries as specified in the incidental take statement (50 CFR §402.14[i][3]).

A. Amount or Extent of Take

NOAA Fisheries anticipates that the proposed action will result in incidental take of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead. Incidental take associated with this action is expected to be in the form of harm or harassment of winter- and spring-run Chinook salmon adults resulting from pile driving, and of winter- and spring-run Chinook salmon and steelhead juveniles resulting from pile driving, cofferdam installation, placement of gravel approach pads, fish salvage, and temporary and permanent loss of SRA habitat. Some mortality (<10 percent of all fish collected) is anticipated from conducting fish salvage within cofferdams. Mortality of all eggs and larvae present in redds constructed within 150 yards of pile-driving activities also is expected.

NOAA Fisheries cannot, using the best available information, quantify the anticipated incidental take of individual winter- and spring-run Chinook salmon and steelhead because of the variability and uncertainty associated with the population size of each species, annual variations in the timing of migration, and uncertainties regarding individual habitat use of the project area. However, it is possible to describe the conditions that will lead to the take. Specifically, take during the four-year project is not expected to exceed that associated with the construction, between April 15 and October 15, of two cofferdams per year; pile driving at or below 120 dB that will startle adults and juveniles in a 600 m radius from the pile-driving source, and kill eggs and larvae in redds within 150 yards of the pile-driving source; two cofferdam fish salvage activities per year that will kill up to ten percent of all fish captured; increased sediment and turbidity from the installation and removal of steel piles and cofferdams at three in-water bridge columns. Loss of riparian vegetation is not expected to exceed 0.66 acres for twenty years. Anticipated incidental take may be exceeded if project activities exceed the criteria described above, if the project is not implemented as described in the biological assessment for the Cypress Avenue Bridge Replacement project, or if the proposed conservation measures listed in the *Description of the Proposed Action* section are not implemented.

B. Reasonable and Prudent Measures

NOAA Fisheries has determined that the following reasonable and prudent measures (RPMs) are necessary and appropriate to minimize the incidental take of listed anadromous salmonids.

1. Measures shall be taken to minimize the amount and duration of pile driving and its potential impacts on listed salmonids.

2. Gravel approach pads shall be constructed and managed so as to minimize potential adverse impacts, and to maximize potential benefits, to listed salmonids from these structures.

3. FHWA/Caltrans shall provide a yearly report summarizing construction activities, species status within 200 yards upstream and downstream of the bridge site, avoidance and/or minimization measures taken, and any observed take incidents.

C. Terms and Conditions

1. Measures shall be taken to minimize the amount and duration of pile driving and its potential impacts on listed salmonids.

    a. All trestle, falsework, and cofferdam piles shall be located and constructed so that, wherever feasible, piles shall be left in place and reused in subsequent stages of the construction process.

    b. To minimize pile-driving impacts on winter- and spring-run Chinook salmon eggs and pre-emergent fry, anti-spawning mats shall be placed over all suitable spawning habitat within the potential impact range of the pile-driving hammers to be used during that season's pile driving. These anti-spawning mats shall be installed no later than April 15 of each construction year, and shall be removed no earlier than October 15 or upon completion of pile-driving activities for that year, whichever comes first.

c. Any pile driving occurring outside of the April 15 through October 15 work window, when anti-spawning mats are not in place, will require additional written authorization from NOAA Fisheries and will be contingent upon verification that a qualified fishery biologist has surveyed 450 feet upstream and downstream of the project and found that no salmonid spawning activity is occurring.

d. Noise from pile-driving activities is not expected to exceed 120 dB. However, FHWA and Caltrans shall conduct acoustic monitoring within the water column and the substrate of the Sacramento River to determine the range and magnitude of compression shock waves generated by pile-driving operations at the Cypress Avenue Bridge Replacement project. Acoustic monitoring must be designed to verify that pile-driving activities do not exceed 120 dB, and if they do, at what range they generate noise levels found to be lethal to juvenile salmonids (204 dB). Exceedances of 120 dB shall be reported to the Sacramento Area Office of NOAA Fisheries within 48 hours (see contact information below).

2. Gravel approach pads shall be constructed and managed so as to minimize potential adverse impacts, and to maximize potential benefits, to listed salmonids from these structures.

a. Gravel size will be between 1 and 4 inches in diameter, and will be uncrushed, rounded natural river rock with no sharp edges.

b. In order to supply clean gravel to downstream spawning habitat, the gravel approach pads shall not be fully removed following their use. Instead, only non-gravel surfacing materials and any other materials which are required to be removed by the California Reclamation Board to avoid flood risk shall be removed. The remaining spawning gravel shall be left in the river channel and allowed to wash downstream and be distributed naturally by high stream flows.

3. FHWA/Caltrans shall provide a yearly report summarizing construction activities, species status within 200 yards upstream and downstream of the bridge site, avoidance and/or minimization measures taken, and any observed take incidents.

   a. FHWA/Caltrans shall provide a summary report by December 31 of each construction year detailing in-water construction activities and the results of acoustic monitoring. Reports will also identify the number of winter- and spring-run Chinook salmon and steelhead redds within 200 yards upstream and downstream of the bridge site on maps, and describe any redds that were damaged as a result of in-water construction activities.

   b. If a listed species is observed injured or killed by project activities, FHWA/Caltrans shall contact the Sacramento Area Office of NOAA Fisheries within 48 hours (see contact information below). Notification shall include species identification, the number of fish, and a description of the action that resulted in take. If possible, dead individuals shall be collected, placed in an airtight bag, and refrigerated with the aforementioned information until directed to do otherwise by NOAA Fisheries.

Updates and reports required by these terms and conditions shall be submitted to:

Supervisor
Sacramento Area Office
National Marine Fisheries Service
650 Capitol Mall, Suite 8-300
Sacramento, CA 95814

FAX: (916) 930-3629
Phone: (916) 930-3600

X. CONSERVATION RECOMMENDATION

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. These conservation recommendations include discretionary measures that the FHWA and Caltrans can take to minimize or avoid adverse effects of a proposed action on a listed species or critical habitat or regarding the development of information. In addition to the terms and conditions of the Incidental Take Statement, NOAA Fisheries provides the following conservation recommendations that would reduce or avoid adverse impacts on the listed species:

1. FHWA and Caltrans should utilize the results of the acoustic studies to evaluate the effects of pile driving on salmonids in order to develop site specific avoidance and minimization measures for future bridge projects.

XI. REINITIATION OF CONSULTATION

This concludes formal consultation on the proposed Cypress Avenue Bridge Replacement project. Reinitiation of formal consultation is required if: (1) the amount or extent of taking specified in any incidental take statement is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the action is subsequently modified in a manner that causes an effect to the listed species that was not considered in the biological opinion; or (4) a new species is listed or critical habitat is designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, formal consultation shall be reinitiated immediately.

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Enclosure 2

Magnuson-Stevens Fishery Conservation and Management Act (MSA)

ESSENTIAL FISH HABITAT CONSERVATION RECOMMENDATIONS[1]
Federal Highway Administration (FHA) Cypress Avenue Bridge Replacement project

I. IDENTIFICATION OF ESSENTIAL FISH HABITAT

The geographic extent of freshwater essential fish habitat (EFH) for the Pacific salmon fishery includes waters currently or historically accessible to salmon within specific U.S. Geological Survey hydrologic units (Pacific Fishery Management Council 1999). For the Sacramento River watershed, the aquatic areas identified as EFH for Chinook salmon are within the hydrologic unit map numbered 18020109 (Lower Sacramento River) and 18020112 (upper Sacramento River to Clear Creek). The upstream extent of Pacific salmon EFH in the Sacramento River is to Keswick Dam at river mile 269.5.

EFH is defined as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. For the purpose of interpreting the definition of EFH, "waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means habitat required to support a sustainable fishery and a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle.

The associated biological opinion thoroughly addresses the species of Chinook salmon listed both under the Endangered Species Act (ESA) as well as the MSA which potentially will be affected by the proposed action–the Sacramento River winter-run Chinook salmon *(Oncorhynchus tshawytscha)* and the Central Valley spring-run Chinook salmon *(O. tshawytscha).* Therefore, this EFH consultation will concentrate primarily on the Central Valley fall/late fall-run Chinook salmon *(O. tshawytscha)* which is covered under the MSA, although not listed under the ESA.

[1] The 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) set forth new mandates for the National Marine Fisheries Service (NOAA Fisheries) and Federal action agencies to protect important marine and anadromous fish habitat. Federal action agencies which fund, permit, or carry out activities that may adversely impact EFH are required to consult with NOAA Fisheries regarding potential adverse effects of their actions on EFH and respond in writing to NOAA Fisheries "EFH Conservation Recommendations." The Pacific Fisheries Management Council has identified essential fish habitat (EFH) for the Pacific salmon fishery in Amendment 14 to the Pacific Coast Salmon Fishery Management Plan.

The Sacramento, Feather, Yuba, American, Cosumnes, Mokelumne, Stanislaus, Tuolumne, Merced, and San Joaquin Rivers, and many of their tributaries, support wild populations of Central Valley fall-/late fall-run (herein "fall-run") Chinook salmon. However, 40 to 50 percent of spawning and rearing habitats once used by these fish have been lost or degraded. Fall-run Chinook salmon once were found throughout the Sacramento and San Joaquin River drainages, but have suffered declines since the mid-1900s as a result of several factors, including commercial fishing, blockage of spawning and rearing habitat, water flow fluctuations, unsuitable water temperatures, loss of fish in overflow basins, loss of genetic fitness and habitat competition due to straying hatchery fish, and a reduction in habitat quality.

Chinook salmon in the Sacramento/San Joaquin Basin are genetically and physically distinguishable from coastal forms (Clark 1929). Additionally, San Joaquin River populations tend to mature at an earlier age and spawn later in the year than Sacramento River populations. These differences could have been phenotypic responses to the generally warmer temperature and lower flow conditions found in the San Joaquin River Basin relative to the Sacramento River Basin. There is no apparent difference in the distribution of marine coded wire tag (CWT) recoveries from Sacramento and San Joaquin River hatchery populations, nor are there genetic differences between Sacramento and San Joaquin River fall-run populations (based on DNA and allozyme analysis) of a similar magnitude to that used in distinguishing other ESUs. This apparent lack of distinguishing life-history and genetic characteristics may be due, in part, to large-scale transfers of Sacramento River fall-run Chinook salmon into the San Joaquin River Basin.

The historical abundance of fall-run Chinook salmon is poorly documented (Myers *et al* 1998) and complete estimates are not available until 1953 (U.S. Fish and Wildlife Service [FWS] 1995). From the late 1930s to the late 1950s estimates for mainstem Sacramento River fall-run fish were obtained from spawning surveys and ladder counts at the Anderson-Cottonwood Irrigation Dam. Although surveys were not consistent or complete, they did yield population estimates for fall-run Chinook salmon in the Sacramento River ranging from 102,000 to 513,000 fish (Yoshiyama *et al* 1998). Average escapement from 1953 to 1966 was 179,000 fish and from 1967 to 1991 was 77,000 (FWS 1995). From 1992 to 1997 the estimated fall-run population in the Sacramento River has ranged from 107,300 to 381,000 fish (Yoshiyama *et al* 1998). Over the last five years average escapement of naturally produced fall-run has been above 190,000; however, 20 to 40 percent of these natural spawners have been of hatchery origin. The increase in salmon runs in the Sacramento River since 1990 may be attributable to several factors including, increased water supplies following the 1987-1992 drought, stricter ocean harvest regulations, and fisheries restoration actions throughout the Central Valley. However, it is unclear if natural populations are self-sustaining or if the appearance of a healthy population is due to high hatchery production. Concern remains over impacts from high hatchery production and harvest levels, although ocean and freshwater harvest rates have been recently reduced.

A. Life History and Habitat Requirements

Central Valley fall-run Chinook salmon are "ocean-type," entering the Sacramento River from July through December, and spawning from October through January. Peak spawning occurs in October and November (Reynolds *et al* 1993). Chinook salmon spawning generally occurs in swift, relatively shallow riffles or along the edges of fast runs at depths up to 15 feet. Preferred spawning substrate is clean loose gravel. Gravels are unsuitable for spawning when cemented with clay or fines, or when sediments settle out onto redds reducing intergravel percolation (NOAA Fisheries 1997).

Egg incubation occurs from October through March, and juvenile rearing and smolt emigration occurs from January through June (Reynolds *et al* 1993). Shortly after emergence from their gravel nests, most fry disperse downstream towards the Delta and estuary (Kjelson *et al* 1982). The remainder of fry hide in the gravel or station in calm, shallow waters with bank cover such as tree roots, logs, and submerged or overhead vegetation. These juveniles feed and grow from January through mid-May, and emigrate to the Delta and estuary from mid-March through mid-June (Lister and Genoe 1970). As they grow, the juveniles associate with coarser substrates along the stream margin or farther from shore (Healey 1991). Along the emigration route, tributary streams are used as rearing habitat. These non-natal rearing areas are highly productive micro-habitats providing abundant food and cover for juvenile Chinook salmon to grow to the smolt stage. Smolts are juvenile salmonids that are undergoing a physiological transformation that allows them to enter saltwater. These smolts generally spend a very short time in the Delta and estuary before entry into the ocean.

In contrast, the majority of fry carried downstream soon after emergence are believed to reside in the Delta and estuary for several months before entering the ocean (Healey 1980, 1982, Kjelson *et al.* 1982). Principal foods of Chinook salmon while rearing in freshwater and estuarine environments are larval and adult insects and zooplankton such as *Daphnia,* flies, gnats, mosquitoes or copepods (Kjelson *et al* 1982), stonefly nymphs or beetle larvae (Chapman and Quistdorff 1938) as well as other estuarine and freshwater invertebrates. All outmigrant Central Valley fall-run Chinook salmon depend on passage through the Sacramento-San Joaquin Delta for access to the ocean. They remain off the California coast during their ocean residence and migration.

II. DESCRIPTION OF THE PROPOSED ACTION

The proposed action is described in the *Description of the Proposed Action* section of the associated biological opinion (Enclosure 1) for the endangered Sacramento River winter-run Chinook salmon, threatened Central Valley spring-run Chinook salmon, and threatened Central Valley steelhead ESUs.

III. EFFECTS OF THE ACTION

EFH will be adversely affected by the permanent loss of approximately 0.045 acre of riparian and wetland vegetation and the temporary disturbance of an additional 0.615 acre of riparian habitat, as well as temporary disturbance *(e.g.,* noise and turbidity) from pile driving and other in-channel construction activities, and temporary occupation of the riverbed and water column by anti-spawning mats, cofferdams, work trestles and gravel approach pads. Temporary losses of habitat in the river channel will affect anadromous species by reducing the onsite rearing and spawning habitat. However, implementation of the proposed project would result in a permanent net increase of riverine habitat since this project would result in three fewer piers being located within the floodplain.

The temporary impacts to riparian vegetation at the project site will last for approximately ten to twenty years. Revegetating the project site and an additional 0.135 acre offsite will quickly offset the adverse effects of removing annual plants; however, habitat attributes related to the replacement of large woody vegetation will not be realized for much longer. Placement of anti-spawning mats and construction of the gravel approach pads will affect EFH by covering and altering the hydrology of suitable spawning habitat for three years, but the remaining gravel will ultimately improve spawning within the action area following the construction period as gravels which are left in the river are redistributed and made available to spawning fish.

IV. CONCLUSION

Upon review of the effects of FHWA's Cypress Avenue Bridge Replacement project, NOAA Fisheries believes that the construction and operation of the project features may adversely affect EFH of Pacific salmon protected under the MSA.

V. EFH CONSERVATION RECOMMENDATIONS

As the habitat requirements of Central Valley fall-run Chinook salmon within the action area are similar to those of the federally-listed species addressed in the attached biological opinion, NOAA Fisheries recommends that Reasonable and Prudent Measures Nos. 1 and 2, and their respective terms and conditions listed in the incidental take statement prepared for the Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead ESUs in the associated biological opinion, be adopted as EFH conservation recommendations. Those terms and conditions which require the submittal of reports and status updates can be disregarded for the purposes of this EFH consultation as there is no need to duplicate those submittals.

VI. ACTION AGENCY STATUTORY REQUIREMENTS

Section 305(b)(4)(B) of the MSA and Federal regulations (50 CFR § 600.920) to implement the EFH provisions of the MSA require Federal action agencies to provide a detailed written response to NOAA Fisheries, within 30 days of its receipt, responding to the EFH conservation recommendations. The response must include a description of measures adopted by the Agency for avoiding, mitigating, or offsetting the impact of the project on Pacific salmon EFH. In the case of a response that is inconsistent with NOAA Fisheries' recommendations, the Agency must explain their reasons for not following the recommendations, including the scientific justification for any disagreements with NOAA Fisheries over the anticipated effects of the proposed action and the measures needed to avoid, minimize, mitigate, or offset such effects (50 CFR 600.920(j)).

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